

# EDN

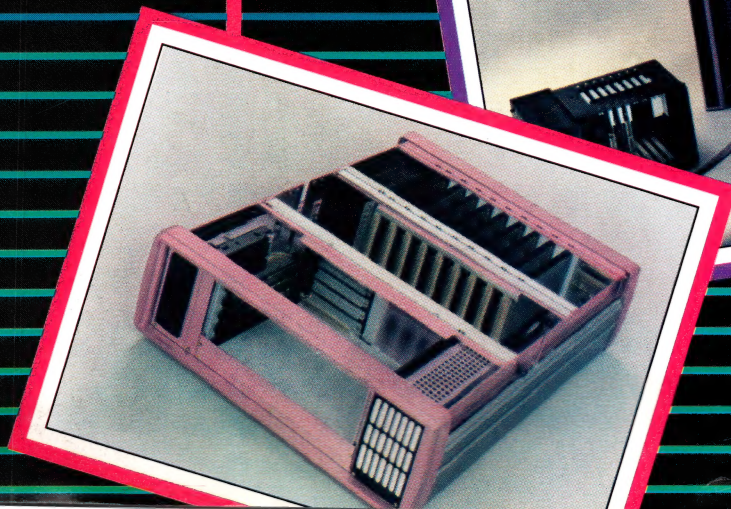
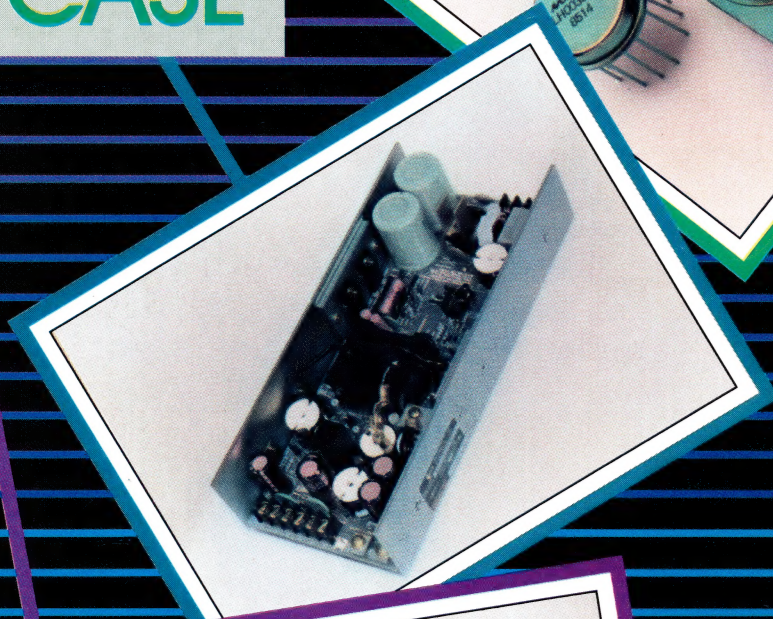
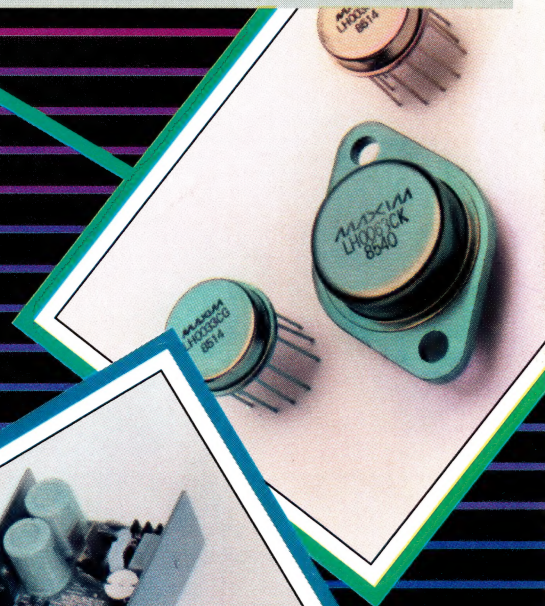
SPECIAL ISSUE—Part 1  
Product Showcase No 24

Highlighting key trends in  
power sources, software,  
ICs & semiconductors, and  
hardware & interconnects

Expanded literature section

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS

## PRODUCT SHOWCASE





# FAST ASIC.

VTC's High-Performance Processes	Minimum Geometry	Metal Layers	Switch Speed	Clock Rate	Bandwidth		Minimum Device Area
					F <sub>T</sub> NPN	F <sub>T</sub> PNP	
Linear High-Density (LHD)	3.0μ	2	1.5ns	60MHz	1GHz	100MHz	1900μ <sup>2</sup>
Complementary Bipolar Process (CBP)	2.0μ	2	500ps	350MHz	6GHz	500MHz	370μ <sup>2</sup>
Current Mode Logic (CML)	2.0μ	2	350ps	1GHz	7GHz	100MHz	370μ <sup>2</sup>
CMOS I	1.6μ	2	0.8-1.5ns	75MHz	—	—	250μ <sup>2</sup>
CMOS II	1.0μ	2	0.4-1.0ns	150MHz	—	—	100μ <sup>2</sup>

## 6GHz Analog Master Chip Family

Versatile, quick-turn bipolar solutions — ideal for such high-performance applications as disk drive subsystems, analog signal processing, linear subsystems, high-speed video graphics, and ATC.

- ☐ Universal CAD interface (SPICE netlist)
- ☐ 500MHz f<sub>T</sub>PNP
- ☐ Four array sizes
- ☐ 2.0μ (CBP) process
- ☐ On-chip oxide capacitors and Schottky devices
- ☐ Up to 68 pins
- ☐ Two-layer metal

## HIGH-PERFORMANCE CMOS ASIC SOLUTIONS:

### 1-Micron CMOS Standard Cell Library

A cost-effective, correct-the-first-time design methodology with proven CAD tools. Performance optimized for driving the large fanouts and long interconnects characteristic of complex, VLSI/VHSIC-oriented designs.

- ☐ 20,000+ gate-equivalent complexity
- ☐ Gate delays less than 575psec (2-input NAND, fanout of 2)
- ☐ 1.0μ (CMOS II) process
- ☐ Two-layer metal
- ☐ Over-the-cell routing
- ☐ High-performance macro families

### CMOS Silicon Compilation

VTC now offers access to the power of the Genesil™ design system from Silicon Compilers, Inc. Only VTC can offer Genesil users the opportunity to design, manufacture, and test in a tempest-level secure facility.

- ☐ Automated layout compilation and routing
- ☐ Rapid architectural tradeoffs
- ☐ 1.6μ (CMOS I) process
- ☐ Interactive simulation and timing analysis
- ☐ Placement, pinout, and packaging aids
- ☐ Standard functions include parallel datapath module, RAM, ROM, FIFO, PLA, random logic functions, pads, external functions
- ☐ Timing checked automatically

### CMOS Gate Array

An extensive, fully characterized macro library that includes multiplexers, decoders, priority circuits, a shifter,

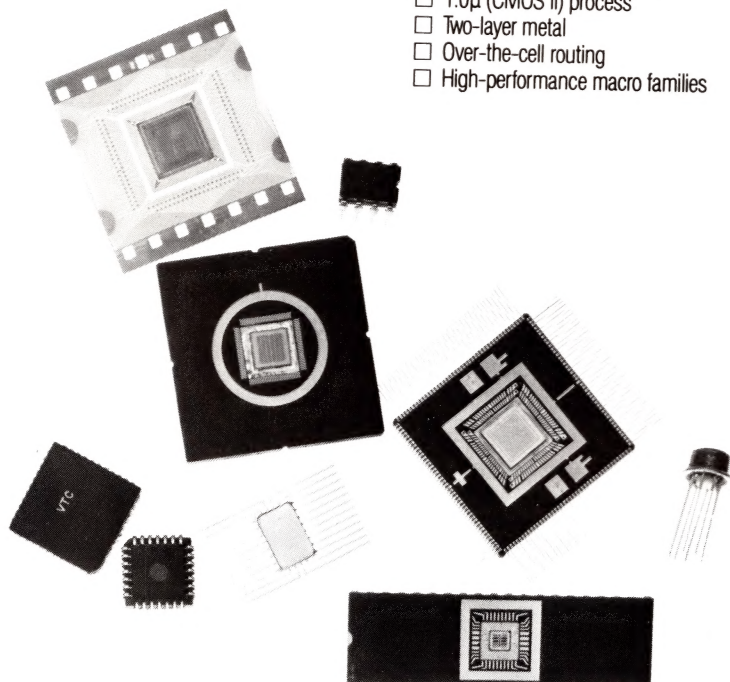
up/down counter, adders, comparators, a 16-word read/write memory, and a large selection of simple gates and flip-flops.

- ☐ Typical loaded gate delays of 0.85ns (2-input NAND, fanout 2)
- ☐ 1.6μ (CMOS I) process
- ☐ Two-layer metal
- ☐ Powerful on-chip test circuitry
- ☐ 6K gates in matrix, plus on-chip maintenance system
- ☐ Up to 172 pins

So, give VTC a yell. Your search for an ASIC vendor isn't complete till you do.

We'll send you a brochure with performance specs that'll have you screaming for joy. VTC Incorporated, 2401 East 86th Street, Bloomington, MN 55420. (In Minnesota, call: 612/851-5200.)

**CALL 800/VTC-ASIC**



Circle No. 3 (Commercial)

Circle No. 42 (Military)

VTC's wide choice of packaging options includes plastic and hermetic DIPs, surface mount, and PGA, plus TAB.



# SCREAMING

## PERFORMANCE YOU CAN COUNT ON: TO 7GHz BIPOLAR OR 150MHz CMOS.

It's a fact worth shouting about: VTC offers more high-performance ASIC solutions than any other vendor. Both bipolar and CMOS.

Our advanced processes give you the performance specs you need to meet your most demanding applications. And your most demanding requirement: staying competitive in today's tough marketplace.

But, VTC gives you even more to count on. Not the least of which is experience: 20 years in IC design and manufacturing to be exact. Which means our quality and reliability have been proven hundreds of times over.

Plus, *total in-house capability* — from design and mask-making, through wafer fabrication, to packaging and testing. With state-of-the-art equipment and facilities to match anyone's . . . anywhere.

And CAD software tools that make first-pass success a reality, not just a possibility.

VTC lets you choose from three basic approaches:

- ☐ Gate array/analog master chip
- ☐ Standard cell libraries
- ☐ Silicon compilation

You can also choose your design approach:

- ☐ Your own staff
- ☐ VTC-authorized design centers
- ☐ VTC factory-based designers
- ☐ Or a combination

Use our proven CAD tools on your choice of workstations, including the IBM PC AT™ or compatible, Mentor Graphics™, DEC VAX™, and the Genesil™ Silicon Compiler.

And, choose your packaging from one of the best selections available today.

Our *BasicASIC™* family already includes eight high-performance ASIC solutions, with more on the way — all available in commercial or military temp ranges.

This wide choice of options, plus our total in-house capability, really make VTC your *one-stop high-performance ASIC source*.

### HIGH-PERFORMANCE BIPOLAR ASIC SOLUTIONS:

#### 1GHz Analog Master Chip Family

Versatile, quick-turn, cost-effective linear solutions — ideal for low-noise, high-bandwidth applications. Very high component counts allow interconnection of densely packed analog functions.

- ☐ Three array sizes
- ☐ 3.0μ (LHD) process
- ☐ On-chip junction capacitors and Schottky devices
- ☐ Up to 68 pins
- ☐ Two-layer metal

#### Analog/Digital Bipolar Cell Library

Easy-to-use, cell-based solutions for high-performance mixed analog/digital systems. Standard cell methodology lets you concentrate on

systems problems without concern for discrete IC design.

- ☐ Linear functions: amps, ADCs, DACs, comparators
- ☐ Digital functions: SSI, MSI, LSI; three power/speed options
- ☐ Memory functions: RAM or ROM
- ☐ TTL or ECL 10K I/O levels
- ☐ Amplifier bandwidths to 200MHz
- ☐ Digital clock rates to 60MHz
- ☐ Component library available
- ☐ Laser-trimmed resistors
- ☐ 3.0μ (LHD) process

#### High-Performance Bipolar Digital Cell Library

Ultra high-speed logic functions, with unlimited I/O flexibility . . . the fastest digital standard cell ASIC solution on the market today. Single-chip complexities to 5000 gates, with demonstrated radiation hardening to one megarad.

- ☐ 350psec propagation delays
- ☐ Digital clock rates to 1GHz
- ☐ ECL 10KH and TTL I/Os available on same chip
- ☐ Suitable for +5, -5, or -5.2 volt power supplies
- ☐ 2.0μ (CML) process

#### High-Performance Analog/Digital Custom Designs

Full custom solutions, with high-performance assured due to our advanced processes . . . for applications requiring high speed, high slew rate, low offsets, large power bandwidth, large output drive capability, fast conversion rates, and high packaging density.



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On the Silicon Frontier™ . .



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PERFORMANCE,  
PURE & SIMPLE.  
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WITH...**





# *value-packed* filters **\$9.95** from

dc to 3GHz

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- greater than 40dB stopband rejection
- 5 section, 30dB per octave roll-off
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- meets MIL-STD-202
- rugged hermetically sealed package (0.4x0.8x0.4 in.)
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setting higher standards

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Domestic and International Telexes: 6852844 or 620156

**CIRCLE NO 4**

LOW PASS	Model	*LP-	10.7	50	70	100	150	200	300	450	550	600	750	850	1000
Min. Pass Band (MHz) DC to			10.7	48	60	98	140	190	270	400	520	580	700	780	900
Max. 20dB Stop Frequency (MHz)			19	70	90	147	210	290	410	580	750	840	1000	1100	1340
Prices (ea.): P \$9.95 (6-49), B \$24.95 (1-49), N \$27.95 (1-49), S \$26.95 (1-49)															

HIGH PASS	Model	*HP-	50	100	150	200	300	400	500	600	700	800	900	1000
Pass Band (MHz) start, max.			41	90	133	185	290	395	500	600	700	780	910	1000
end, min.			200	400	600	800	1200	1600	1600	1600	1800	2000	2100	2200
Min. 20dB Stop Frequency (MHz)			26	55	95	116	190	290	365	460	520	570	660	720

Prices (ea.): P \$12.95 (6-49), B \$27.95 (1-49), N \$30.95 (1-49), S \$29.95 (1-49)

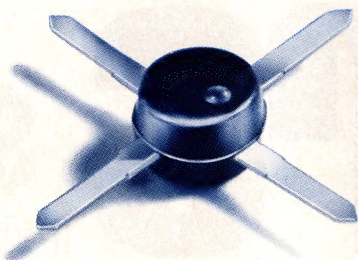
\*Prefix P for pins, B for BNC, N for Type N, S for SMA example: PLP-10.7

C105 REV. B



# 99¢

from



## dc to 2000 MHz amplifier series

### SPECIFICATIONS

Model	Frequency MHz	Gain, dB (min.)	Max. Power dBm (typ)	NF dB (typ)	Price \$ Ea.	Qty.
MAR-1	DC-1000	13	0	5.0	0.99	(100)
MAR-2	DC-2000	8.5	+3	6.5	1.50	(25)
MAR-3	DC-2000	8	+8	6.0	1.70	(25)
MAR-4	DC-1000	7	+11	7.0	1.90	(25)
MAR-7	DC-2000	8.5	+4	5.0	1.90	(25)
MAR-8	DC-1000	21	+10	3.5	2.20	(25)

### designers amplifier kit, DAK-1

5 of each model, total 30 amplifiers  
only \$49.99

Unbelievable, until now... tiny monolithic wide-band amplifiers for as low as 99 cents.

These rugged 0.085 in. diam. plastic-packaged units are 50 ohm input/output impedance, unconditionally stable regardless of load, and easily cascable. Models in the MAR-series offer from 7 to 21dB gain, 0 to +10dBm output, noise figure as low as 3.5 dB (5.5dB typical), and up to DC-2000MHz bandwidth.

Also, for your design convenience, Mini-Circuits offers 10pf to 0.055 $\mu$ f chip coupling capacitors for the MAR-amplifiers at only 12 cents each.

finding new ways ...  
setting higher standards



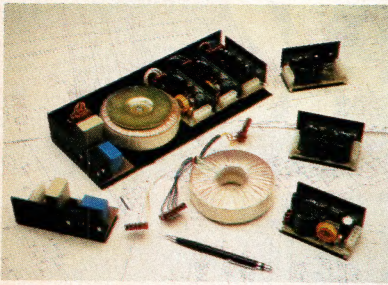
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C113 REV. A

EDN December 11, 1986





*Modular supplies are attractive choices for applications that can't accommodate standard multiple-output units (pg 240).*

## **DESIGN FEATURES**

### **Hardware and Interconnect Devices**

#### **Heat-removal devices hold semiconductors within operating ranges 76**

Besides the usual fans and blowers used to carry heat away from semiconductors, you have access to a variety of local cooling devices that help keep junction temperatures down.—*Bill Travis, Senior Editor*

### **ICs and Semiconductors**

#### **LAN ICs let you build networks for PCs 136**

VLSI technology has finally reduced chip costs enough to help you build reasonably priced LAN-node cards for insertion in personal-computer-based workstations. Yet chip makers and designers of these boards alike are still debating over which LAN standards provide the most cost-effective way to implement your PC network.—*Denny Cormier, Regional Editor*

### **Software**

#### **$\mu$ P simulators let you debug software on an IBM PC 196**

Software simulators that execute on the IBM PC and compatibles allow designers to debug ROMable software for a variety of  $\mu$ Ps. PC-based simulators generally offer more sophisticated software-debugging features than do expensive in-circuit emulators, yet they fit into the budgets of even small engineering departments.—*Maury Wright, Regional Editor*

### **Power Sources**

#### **User-configurable power supplies speed development 240**

Modular, user-configurable power supplies let you quickly assemble the exact combination of voltages and currents that your application requires. Unfortunately, there are tradeoffs involved in using such supplies, and intermediate solutions do exist.—*Charles H Small, Associate Editor*

*Continued on page 7*

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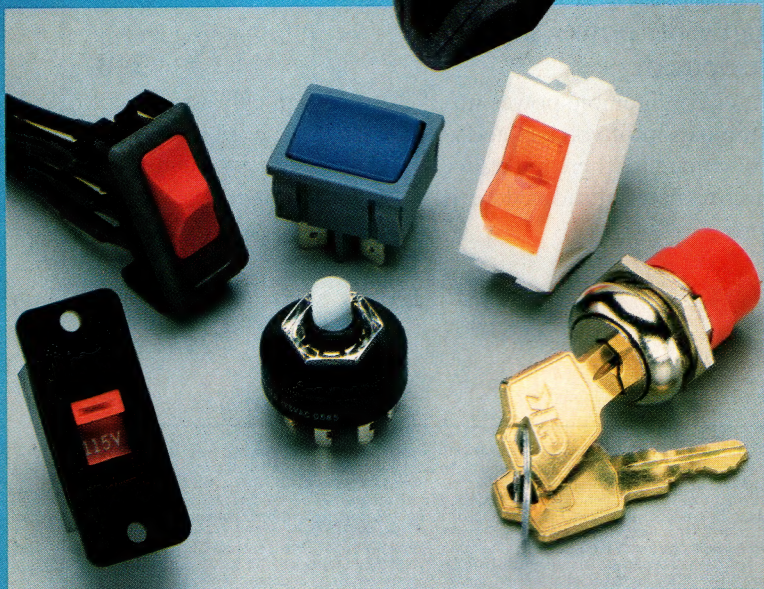


# POWER SWITCHES FROM C&K



## NEW Snap-In Slides

The latest addition to the C&K line is the S Series Snap-In Slide Switch. Compact contemporary design with many "Value Added" features, such as wire leads, harnesses with connectors and jumper strips to provide reversing capabilities. Bezels and slides available in nine contrasting or matching colors. Patent Pending.



C&K has the greatest variety of **low cost**, high volume power switches in Slide, Rocker and Rotary motion. Ratings up to 15 amps, single or double pole, with quick connect, solder lug or wire lead terminals. All switches are UL/CSA listed and many are available with International approvals.

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CIRCLE NO 6





*On the cover: Part 1 of EDN's Product Showcase No 24 highlights innovative hardware and interconnect devices (pg 87), ICs and semiconductors (pg 151), software packages (pg 209), and power sources (pg 247). (Cover concept by Kathleen Ruhl; photos hand tinted by Wayne Dreese)*

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# If you don't believe our PCB warranty, ask the people who've collected on it.

Our warranty is this: If you discover you've received a bad board, we'll pay for it.

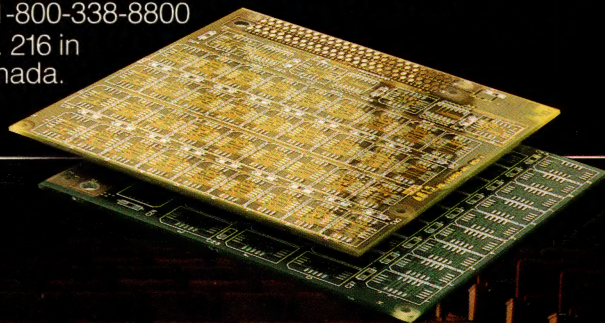
The thing is, we rarely have to. In fact, the quality of our boards is so reliable, some of our customers have stopped incoming board tests altogether.

And we're not just talking about simple two-sided boards, either. We specialize in building dense multi-layer and surface mount PCBs, using technologies refined and perfected by our own engineers.

Best of all, the farther away you are, the farther we go to help meet your deadlines. The result is an

on-time delivery record unequalled in the circuit board industry.

So, even though you'll never get rich collecting on our warranty, think of the time and money you'll save by never having a bad board. Join our large audience of satisfied customers and send your next PCB manufacturing order to Tektronix. Call 1-800-222-2600 ext. 216 in the U.S., or 1-800-338-8800 ext. 216 in Canada.





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## EDITORIAL

51

Young people—in particular high-school students—need a realistic exposure to engineering before selecting it as a college major. One way to accomplish this goal is to open US trade show to students.

## PROFESSIONAL ISSUES

305

Recruiting engineers to the South Bronx is a task less difficult than it seems.—*Deborah Asbrand, Staff Editor*

## LOOKING AHEAD

315

Rectifier market to grow at a 10.2% annual rate . . . Network expenditures: A colossal waste? . . . DP/MIS budgets to stress control over transmission.

## DEPARTMENTS

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## A product-oriented design aid

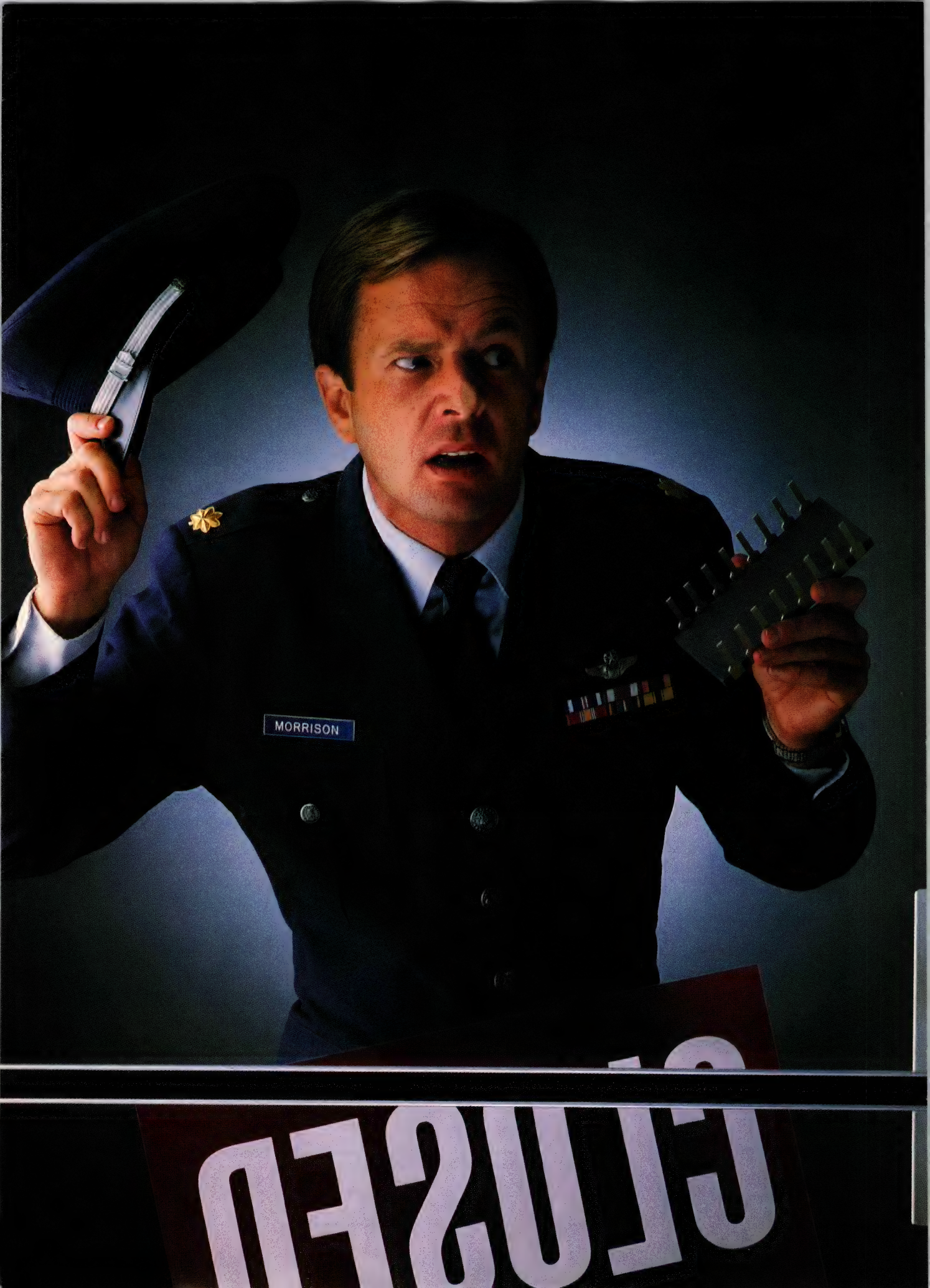
To save you time in your efforts to keep current, EDN's editors have surveyed the new-product offerings from thousands of companies, screening and selecting only the most significant of those offerings introduced in the last six months. We present our findings—the best of the best—in a format devised to make your product selection as easy as possible. You can keep this Product Showcase as a reference until the next one that covers these four key product areas appears in July.



**VBPA ABP**

**Cahners Publishing Company** ☐ A Division of Reed Publishing USA ☐  
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Interior Design ☐ Electronics & Computers ☐ Foodservice & Lodging ☐  
Manufacturing ☐ Book Publishing & Libraries ☐ Medical & Health Care ☐  
Child Care/Development





STAY



# YEARS FROM NOW, WILL YOUR MILITARY SUPPLIER BE JUST A BAD MEMORY?

It's no secret—there's a lot of uncertainty in the marketplace. You never know if the company you're dealing with today will still be around to service you tomorrow. And that's a chance you can't take—especially in the military market.

With INMOS, you're not taking any chances. We have a seven-year history of supporting all major military defense programs with static and dynamic RAMs. Our fabrication facilities are fully compliant with MIL-STD-883C; with military burn-in, performance testing and quality assurance conducted in Colorado Springs.

We have your future in mind with our new CMOS military SRAMs (with performance to 35ns over the full military temperature range) and military low power battery backup CMOS SRAM products. We're the only company in the world to produce 64K and 256K DRAMs with RAS access times down to 80ns, and we're going to keep on producing and servicing innovative military products year after year.


For military products you can depend on, count on INMOS—the beginning of a very good memory.

16K SRAMs		
Device	Process	Access Times
IMS1400M (x1)	NMOS	45, 55, 70ns
IMS1420M (x4)	NMOS	45, 55, 70ns
IMS1403M (x1)*	CMOS	35, 45, 55ns
IMS1423M (x4)	CMOS	35, 45, 55ns

64K CMOS SRAMs	
Device	Access Times
IMS1600M (x1)*	45, 55, 70ns
IMS1620M (x4)*	45, 55, 70ns
IMS1624M (OE, x4)*	45, 55, 70ns
IMS1630M (x8)*	45, 55, 70ns

MILITARY DRAMs		
Device	Process	RAS Access Times
IMS2600M (64Kx1)	NMOS	100, 120, 150ns
IMS2800M (256Kx1)	CMOS	80, 100, 120, 150ns
IMS2801M (256Kx1)	CMOS	80, 100, 120, 150ns

\*Also available as Low Power Battery Backup CMOS SRAMs with I<sub>dr</sub> of 10μA (typical I<sub>cc</sub> at 2V at 25° centigrade).

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## MIL-STD-883C RAMs



INMOS, Colorado Springs, Colorado, Tel. (303) 630-4000;  
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CIRCLE NO 8



# SIEMENS

**A jump ahead in quality.**  
**Two million ICs tested to destruction.**  
**At Siemens.**

If you want to be out front in electronic components you need to have that something extra when it comes to product quality and reliability. Easier said than done. Siemens subjects two million integrated circuits yearly to destructive tests. Experience from these endurance tests helps us to supply our customers with what's better: delivery quality and longterm reliability prove it. And they're assured for the future too.

It's all guaranteed by 27,000 employees. And the thousands of million marks going into research and development annually. That's a foundation Siemens customers can bank on, worldwide.

Everything it takes in electronics.  
Siemens.

Not only product quality, service has to be right too. Adherence to specification and schedule,

flexibility, all-round documentation are matter-of-course for Siemens customers.



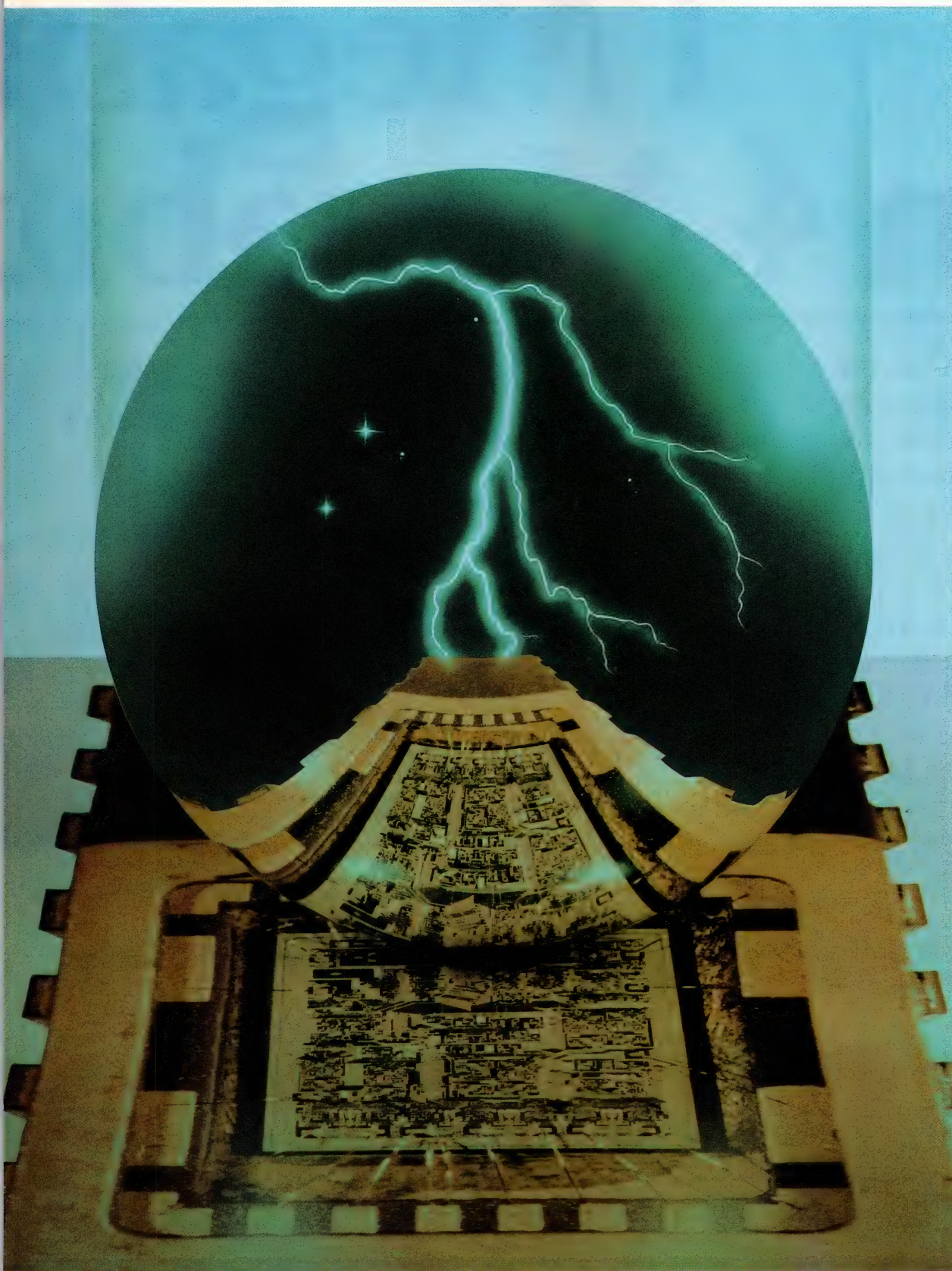
The number of chips per board is constantly growing. That pushes up the demands for freedom from

error and proof against failure. Siemens is way ahead in fulfilling them: of 1,000 components not a single one may

fail after 48 hours of endurance testing at 125°C ambient temperature.

Component quality also means using application experience. Here Siemens has the benefit of the know-how of its system experience.

Siemens AG,  
Components Group,  
Balanstrasse 73,  
8000 Munich 80,  
West Germany.

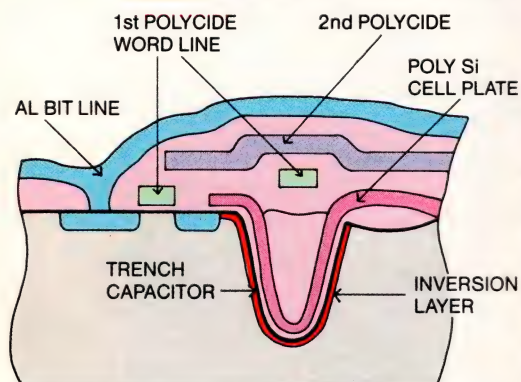


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# Entrenched 1 Megabit in 4 Megabit

That the future belongs to large capacity memory components is not hard to visualize, but it takes real vision and know-how to produce a solution today that meets the demands of tomorrow. So it's no coincidence that NEC's 1 Megabit DRAM features technological advances identified with the 4 Megabit realm. The NMOS chip is based on double level polycide technology and uses a 1.0  $\mu$  design rule. And of course, there is the



MEMORY CELL WITH A TRENCH CAPACITOR

revolutionary trench capacitor design that puts the chip way out in front of products using the conventional planar capacitor method.

The result is a 1 Megabit DRAM of extremely compact dimensions. In fact, the die size is less than 50 sq mm in cross-section. The tiny size permits a

meaningful choice in space-saving packaging – either a 300-mil wide 18-pin plastic DIP, or a SOJ housing appropriate



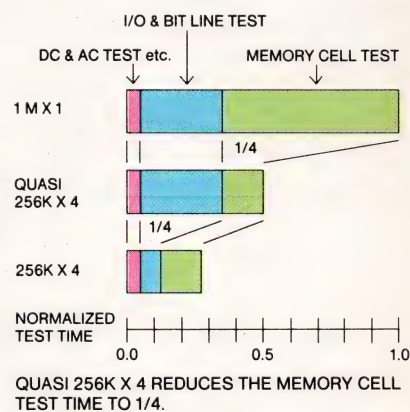
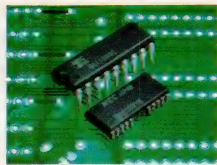
# in the Future t DRAM Technology!



for surface-mounting techniques. Not to mention increased product reliability thanks to radically improved alpha particle resistivity, which results in a soft error rate matching that of a 256 Kbit DRAM.

The 1 Megabit DRAM is organized as 1,048,576 X 1 bit and operates off a single 5V power supply. Functions include nibble or

page mode, CAS-before-RAS refresh, and sophisticated test circuitry. NEC have integrated a 4-bit wide test mode that cuts total testing time by up to half. This keeps testing costs down, but maintains a high level of product reliability – essential factors in volume production of large capacity memory chips.



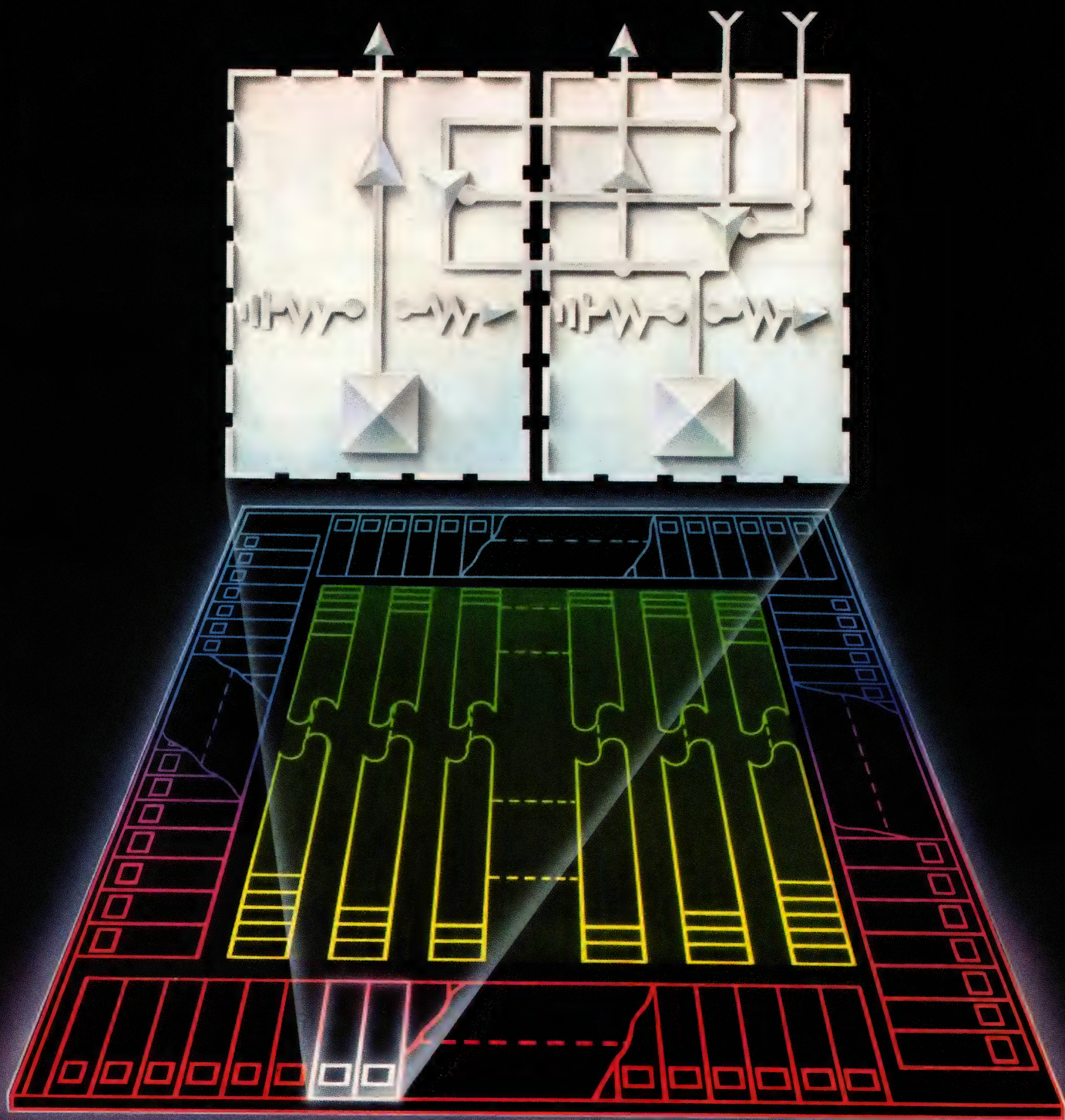
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### Advanced 2-Micron HCA62A Series HCMOS Macrocell Arrays

Array Type	Gate Equivalent	Primary Cells	Available I/O Pads	Available Packages (# Pins)
HCA62A06	648	216	44	16-44
HCA62A10	957	319	52	24-52
HCA62A17	1638	546	68	28-68
HCA62A25	2448	816	84	40-84
HCA62A36	3600	1200	100	40-100
HCA62A50	4968	1656	124	40-120
HCA62A85	8568	2856	168	68-168

### Universal I/O buffers take you from schematic to semicustom chip. Fast.

Our advanced HCA62A Series lets you move from concept to finished silicon with ease and speed, letting you put the signal and power pins anywhere you want them. For high output drive, you can parallel up to six output cells on a chip for 24 mA through a single pin. If that isn't unique enough, the same cells you paralleled to obtain the higher drive can still be used as array inputs. You can have

your cake and eat it too: high output drive without reduced pin utilization. That's a Motorola exclusive.

Still another creative feature of the HCA62A Series is integral oscillator macros. Adjacent input buffers can form on-chip oscillators, with frequencies controllable from 1.0 to 60 MHz, for clocking internal cells. Frequencies are adjusted simply, with an external RC and crystal network.

### Replace conventional gates to 10K.

Thanks to 100% utilization and routability, Motorola's HCA62A Series will replace conventional gate arrays of up to 10,000-gate density. They're also the industry's most flexible devices, with availability in practically every packaging and pin configuration from 16-pin dual in-line to 168-pin

PGA, in plastic and ceramic. The series also provides high latch-up immunity and 3 kV ESD protection. Licensed alternate sourcing is available, too.

### Complete, easy-to-use CAD development.

Perhaps as important, our high-speed, low-power HCA62A Series Macrocell arrays are supported by a complete CAD development system to quickly translate your design into working silicon. All you

need to design using Motorola's CAD system is an ASCII-type terminal and a modem. Or, you can use your own engineering workstation such as Daisy, Mentor, P-CAD™ or FutureNet supported by terrific software.

Interface is that easy.

Motorola also provides a comprehensive, efficient hardware library which includes an oscillator with clock buffer. Functions are being added almost daily to make putting '62A Series performance into new or old designs even easier.

With HCA62A Series macros you can easily grow into standard cells which offer identical functions in both 3- and 2-micron technologies.

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Give your designs the simplicity, flexibility, performance and quality of Motorola semicustom arrays. Give them the edge.

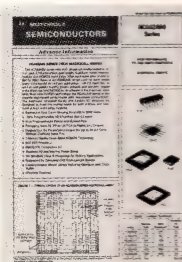
For direct discussion of the HCA62A00 Series arrays, contact a Motorola Regional ASIC Design Center or your Motorola sales office. For literature, send in the completed coupon.

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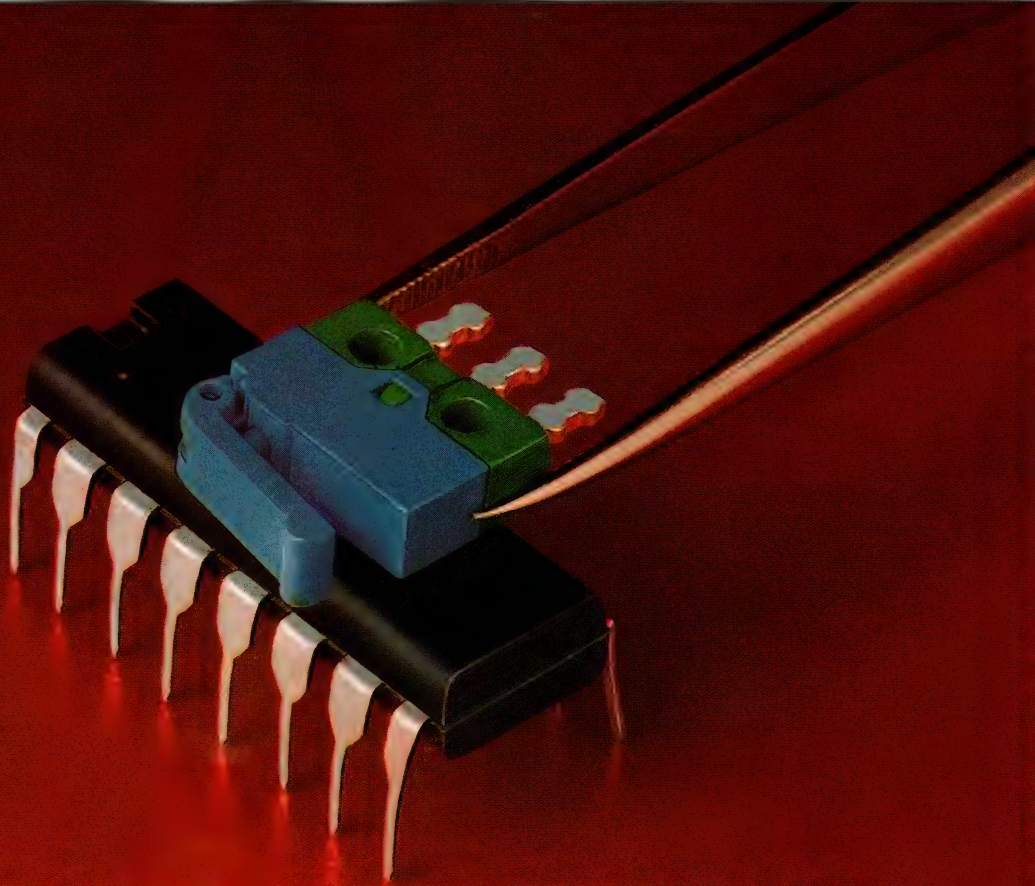


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# NEWS BREAKS

EDITED BY JOAN MORROW

## **TRIPLE 8-BIT VIDEO DAC SUPPORTS 2048×1536-PIXEL RESOLUTION**

The ECL Bt109 video D/A converter operates at video rates to 250 MHz max; it therefore fits video applications with resolution to 2048×1536 pixels. Brooktree (San Diego, CA, (619) 452-7580) offers the IC in a 40-pin DIP for \$39 (1000). The monolithic device includes three 8-bit DACs with RS-343A-compatible outputs. The DACs feature  $\pm \frac{1}{2}$ -LSB differential linearity and 1-nsec max rise/fall time. The company also offers ECL static RAMs and ECL/TTL octal transceiver/translator chips to complement the video DAC in system designs.—Maury Wright

## **DSP SOFTWARE FOR IBM PC WORKS WITH 166-kHz A/D BOARD**

By combining the Transview spectrum and transfer analysis package with the A2D 160 A/D converter board, you can extract a signal from a noisy linear system after one reading. Microway (Kingston, MA, (617) 746-7341) offers both Transview and the A2D 160. Transview sells for \$250 (non-copy-protected), and the A2D 160 with two anti-aliasing modules costs \$1745.

Under software control, the A2D 160 applies a pseudorandom noise signal to the system under test and records the response. Transview computes the system impulse response and generates the FFT (or the chirp-Z algorithm for non-power-of-two lengths) to obtain the system transfer function. Traditional impulse testing for noisy systems requires averaging a large number of readings.

The program executes a 1024-point FFT in approximately one second; a 1000-point chirp-Z transform requires eight seconds. In open-loop mode (without applying a stimulus), Transview acts as an FFT spectrum analyzer.—Margery S Conner

## **SONY ENTERS WORKSTATION MARKET WITH 32-BIT- $\mu$ P MACHINE**

The News workstation from Sony Corp features two processors and supports the Unix 4.2 BSD operating system. The 430×370×130-mm workstation gives the performance of a superminicomputer for the price and size of a personal computer, according to the company. The Model 810, which costs ¥950,000 (\$6130), has 2M bytes (4M bytes max) of memory; the \$11,290 Model 820 provides 4M bytes of memory; and the Model 830, selling for \$17,742, incorporates 8M bytes (16M bytes max). The workstations also incorporate the Ethernet LAN and FNS file system.—Joan Morrow

## **DREW EARNS MOST VOTES IN IEEE ELECTION; FEERST CONTESTS**

In an election in which more than 52,000 votes were cast, just 242 votes separated the winner and the runner-up in this year's IEEE president-elect campaign. Specifically, 18,374 IEEE members threw their support to Russell Drew, president of Viking Instruments (Sterling, VA), and 18,132 votes were cast for Irwin Feerst, an engineering consultant from Massapequa, NY. Third-place finisher with 15,828 votes was Merlin Smith, a manager of systems technology for IBM's Thomas Watson Research Center (Yorktown Heights, NY).

Never one to retreat from a challenge, Feerst filed a formal objection to the election results in the second week of November. IEEE bylaws require that Credentials Committee members make a determination on the complaint within 30 days of receiving a copy of it. The committee can't overturn the election results, but it can call for a new election. Either party has 10 days to file an appeal of the committee's decision. In case of an appeal, the IEEE Executive Committee issues a final determination.



# NEWS BREAKS

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Feerst, spokesman for the Committee of Concerned EEs, is best known for his outspoken criticisms of the IEEE. The election was his fifth and most nearly successful attempt to become IEEE president. Feerst launched four campaigns from 1975 to 1979, losing three times and withdrawing once. He won a spot on this year's ballot by collecting signatures from more than 2200 IEEE members.

The position of president is a two-year term: The winning candidate serves the first year as president-elect and the second year as president.—Deborah Asbrand

## **HYBRID PROVIDES COMPLETE STRAIN-GAUGE CONDITIONING**

The Model 1B31 is the industry's first hybrid strain-gauge signal conditioner, according to its manufacturer, Analog Devices (Norwood, MA, (617) 461-3643). Housed in a 28-pin double-width DIP, the device is one-third the size and two-thirds the price of the closest alternative—the company's Model 2B31 module. Both provide an interface between half- or full-bridge strain-gauge transducers used in the measurement of strain, torque, force, and pressure.

The hybrid 1B31 includes half-bridge completion resistors, an adjustable bridge-excitation source (4 to 15V), an instrumentation amplifier with resistor-programmable gain (2 to 5000), and a filter with programmable cut-off frequency (10 Hz to 20 kHz). It also specs 0.005% max nonlinearity error, 0.25- $\mu$ V/°C typ drift, and 140-dB CMR (for a 10-Hz bandwidth). The 1B31 comes in a plastic package, operates over -25 to +85°C, and costs \$45 (100).—Tarlton Fleming

## **TELECONFERENCING SOFTWARE LETS TWO USERS MODIFY DRAWINGS**

In-Synch teleconferencing software from American Video Teleconferencing Corp (Farmingdale, NY, (516) 420-8080) allows two users of IBM PCs or compatibles to use the same CAE, spreadsheet, or word-processing program simultaneously over a telephone line. Once you've established modem communication with your correspondent, either one of you can load an AutoCAD drawing, a spreadsheet, or a document, and both of you can modify it or post notes and comments in special windows at any position on the document.

You can use the \$149.95 RAM-resident teleconferencing package, which occupies less than 128k bytes of memory, with any application that runs on the Enhanced Graphics Adapter or Hercules color and monochrome adapters, with or without expanded memory conforming to the Lotus/Intel/Microsoft Expanded Memory Specification. The changes you make to a display at either station are immediately displayed on both screens simultaneously.—Chris Terry

## **LASER PRINTER SUITS SMALL, MEDIUM MAINFRAMES**

A new addition to Hitachi Ltd's line of laser printers, the H-6273, prints at 1500 lpm and is designed for small- and medium-scale mainframe systems. The H-6273 is about half the size of the H-8172, a 3000-lpm unit. Rental price is ¥370,000 (\$2387) per month. Hitachi claims it has reduced the size of the device by using a semiconductor laser instead of a conventional gas laser.—Joan Morrow

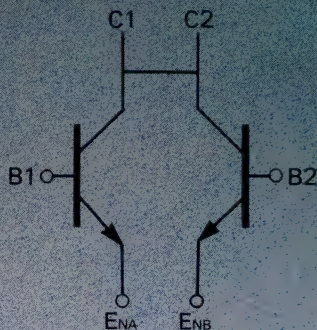
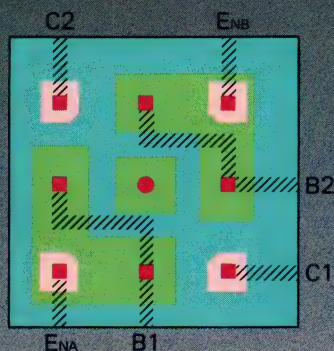
## **BOARD LETS YOU USE YOUR PC FOR FAX COMMUNICATIONS**

The FX-BM88 facsimile board from Panasonic Industrial Co, Computer Products Div (Secaucus, NJ, (201) 348-7183), is a \$1000 plug-in board that allows IBM PCs and compatibles to exchange documents and drawings with any Group III (CCITT international standard) facsimile machine. You can send documents directly from the screen or from a disk file. You can capture incoming documents directly to a disk file, or you can

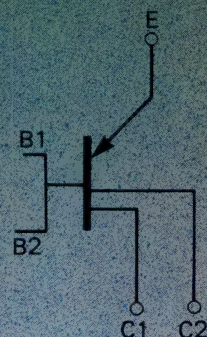
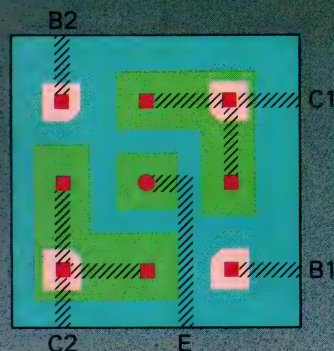


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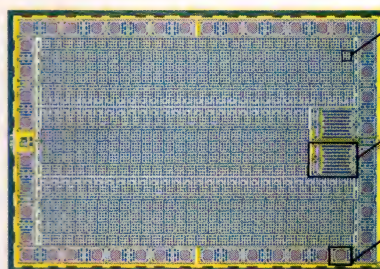
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# NEWS BREAKS

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display them on the screen and edit them with the editor that is included in the package before sending them to a printer or a disk file. The built-in modem provides transmission rates as high as 9600 bps, and the software provides automatic dialing from a stored telephone directory. You can specify the time at which transmission will occur and take advantage of reduced rates for off-peak calls. Evaluation units will be delivered next month, and volume shipments will start in March.—Chris Terry

## **CIRCUIT INTEGRATES REAL-TIME CLOCK WITH STATIC RAM**

A recently introduced memory device from Thomson Components-Mostek Corp (Carrollton, TX, (214) 466-6088) integrates a real-time clock with a battery-backed-up CMOS static RAM in a DIP. The MK48T02, also dubbed the Timekeeper, combines a crystal, a lithium cell, a 2k×8-bit static RAM, clock circuitry, and power-fail-detect and power-switching circuitry. Available in versions specifying access times from 120 to 250 nsec, the device is compatible with any JEDEC-standard 24-pin static-RAM, EPROM, or EEPROM socket.

The IC periodically stores time data in the upper 8 bytes of the 2k×8-bit static RAM. This data, which comprises seconds, minutes, hours, day, month, and year, is available in a byte-wide BCD format; you can access the data as normal static-RAM data in the top seven RAM locations. The MK48T02 does not require you to write long passwords to access the clock data or to convert serial clock data to byte-wide format. Access to a control byte at the eighth location allows you to calibrate the clock through software, thereby eliminating the need for external trim capacitors. The Timekeeper is available in versions that provide two different power-fail-detect ranges: 4.75 to 4.5V, and 4.5 to 4.2V. Write protection automatically occurs upon the detection of a power-fail condition. The IC costs \$17 to \$27.12 (100).—Bill Travis

## **TEKTRONIX ACQUIRES LOGIC-ANALYZER COMPANY**

Tektronix Inc (Beaverton, OR) has purchased TLB Controls (Broomfield, CO), maker of the Breeze line of low-cost logic analyzers. Tektronix will use the Breeze products to round out the lower end of its logic-analyzer line, which is now occupied solely by Sony-Tektronix products imported from Japan. Although TLB will become a branch of Tektronix, it will continue to make instruments in Colorado. Tektronix will take over sales and service of Breeze equipment.—Charles H Small

## **COLLEGE SET UP TO ALLEVIATE PREDICTED PROGRAMMER SHORTAGE**

Japan's Ministry of International Trade and Industry (MITI) will start a new educational program in fiscal 1987 to train computer-software engineers. Called the Information College, the program calls for creating a national network of training centers within already established educational institutions. MITI's move is in response to the government's prediction that the nation will have a shortage of 600,000 programmers by 1990.—Joan Morrow

## **MICROELECTRONICS SOCIETY ANNOUNCES CALL FOR PAPERS**

The International Society for Hybrid Microelectronics has set March 1 as the deadline for papers to be presented at the 1987 International Symposium, which will be held on September 28 to 30, 1987, in Minneapolis, MN. Topics can include but are not limited to surface-mount technology, hybrid-circuit technology, CAD/CAM, military microelectronics, and fiber-optic sensors. For more information, you can contact Don Erickson, Technical Program Chair, ISHM '87, 7314 Oakland Ave, Minneapolis, MN 55423, or phone (612) 866-4383.—Joan Morrow



# Standards Update

## EMISSIONS CRACKDOWN— INSIDE THE FCC



It began in August, 1985, with a one million dollar seizure at Seequa Computer, followed with a crackdown on microcomputer manufacturers (March, 1986). Then in April, the FCC swept through Comdex, levying more than \$250,000 in fines. The ominous nature of these actions by the FCC to enforce its computer emissions standards has left the industry wondering "What's next?" According to the leading laboratory in the field, Dash, Straus & Goodhue, Inc., of Boxborough, Massachusetts, it will be a move by the FCC to use its own

Laurel, Maryland, laboratory to test mass marketed PCs to see who's non-compliant. The full range of FCC penalties, fines, seizures and arrests, could follow. In addition, the FCC has begun checking Customs files to see if the required FCC "740" form has been included. Failure by importers to file can result in a host of Customs related penalties in addition to the FCC's.

Help is on the way, however, from Dash, Straus & Goodhue (617 263-2662), the Northeast's largest testing, research and development firm dedicated to EMI, telecom and safety compliance. Customers can call DSG and receive, over the phone, a commitment to have a device tested, modified (if necessary), retested and verified within a guaranteed time for a guaranteed rate. DSG is an NBS accredited laboratory for emissions and telecommunications testing.

Circle Reader Service No. 30 for Dash, Straus & Goodhue.

## IS DDS THE NEXT TARGET FOR THE FCC?

Since it issued its Third Report and Order, Docket 81-216, in November of last year, the FCC has required nearly all manufacturers of Digital Data Systems to register their designs with the FCC. This includes Channel Service Units (CSU), Network Channel Terminating Equipment (NCTE), and nearly any device that interfaces with T1 or substrate lines. Also included are devices that encode analog signals, even though they interface through NCTE or CSU. Some manufacturers have been slow to comply, and their competitors have filed charges. The FCC has responded, issuing forfeitures to three manufacturers based on a complaint by Verilink.

Registering equipment for DDS connection is tricky. One lab proficient in the field is Dash, Straus & Goodhue, Inc., of Boxborough, Massachusetts. As an extra plus, the firm is one of the few labs also approved by the Canadian Department of Communications and can arrange for approvals in Canada as well.

## PRODUCT SAFETY— REFORM GAINS BUT LISTING IS BEST

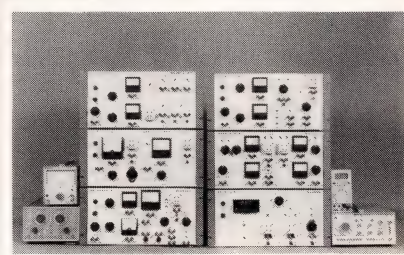
Efforts to reform product liability laws have made slow gains in Congress. The liability Tort Reform Bill S.2760 has passed the Senate Commerce Committee 10 to 7. Basically, it encourages settlement by requiring manufacturers to make a reasonable offer in settlement prior to trial. If not accepted, the injured party's claim for pain suffering is limited to \$250,000. But progress and reform is slow and sure to run into opposition in the House. The best bet to hedge



against lawsuits may be UL® listing and CSA® certification. While not a complete defense, failure to meet standards could leave a manufacturer with practically no defense in cases of shock or fire hazards. These and other worldwide safety approvals can now be obtained through one company, Dash, Straus & Goodhue, Inc. DSG can design, test, and coordinate submittals of products for UL, CSA, and West German approvals, often handling them simultaneously. Final tests carried out by these organizations are coordinated through DSG.

## NEW INSTRUMENTS SPEED COMPLIANCE

An integrated workstation designed for the complete evaluation of telephones, modems, PBXs etc. for compliance with FCC Part 68, DOC DS-03 and EIA standards is now available from Compliance Design Inc. (617 264-4668). The

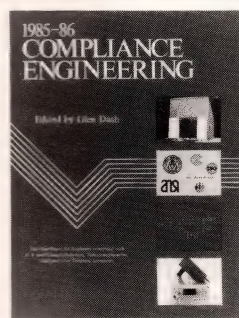


Workstation makes setting up Part 68 laboratories practical for those manufacturers who wish to avoid heavy independent laboratory testing fees. The Workstation has become especially popular for manufacturers since they now have to meet the FCC's requirement of a six-month recheck on all equipment previously registered.

To ensure EMI compliance, CDI also makes available the famous Roberts Antenna®. The antenna is known for its near lossless receive characteristics and is identical to those used by the FCC for 25 years. Now an industry standard, the company guarantees that any reasonable site can meet the FCC's critical site attenuation requirements of OST-55 by using these antennas. In fact, as part of a package, CDI's engineers will test any customer's site and file it with the FCC, a prerequisite to using it for EMI testing. The antenna was designed by Willmar Roberts, former Assistant Chief Engineer of the FCC's laboratory in Laurel, Maryland. It is available exclusively from Compliance Design.

Circle Reader Service No. 69 for Compliance Design Inc.

## THE BEST IS AVAILABLE—FOR FREE!



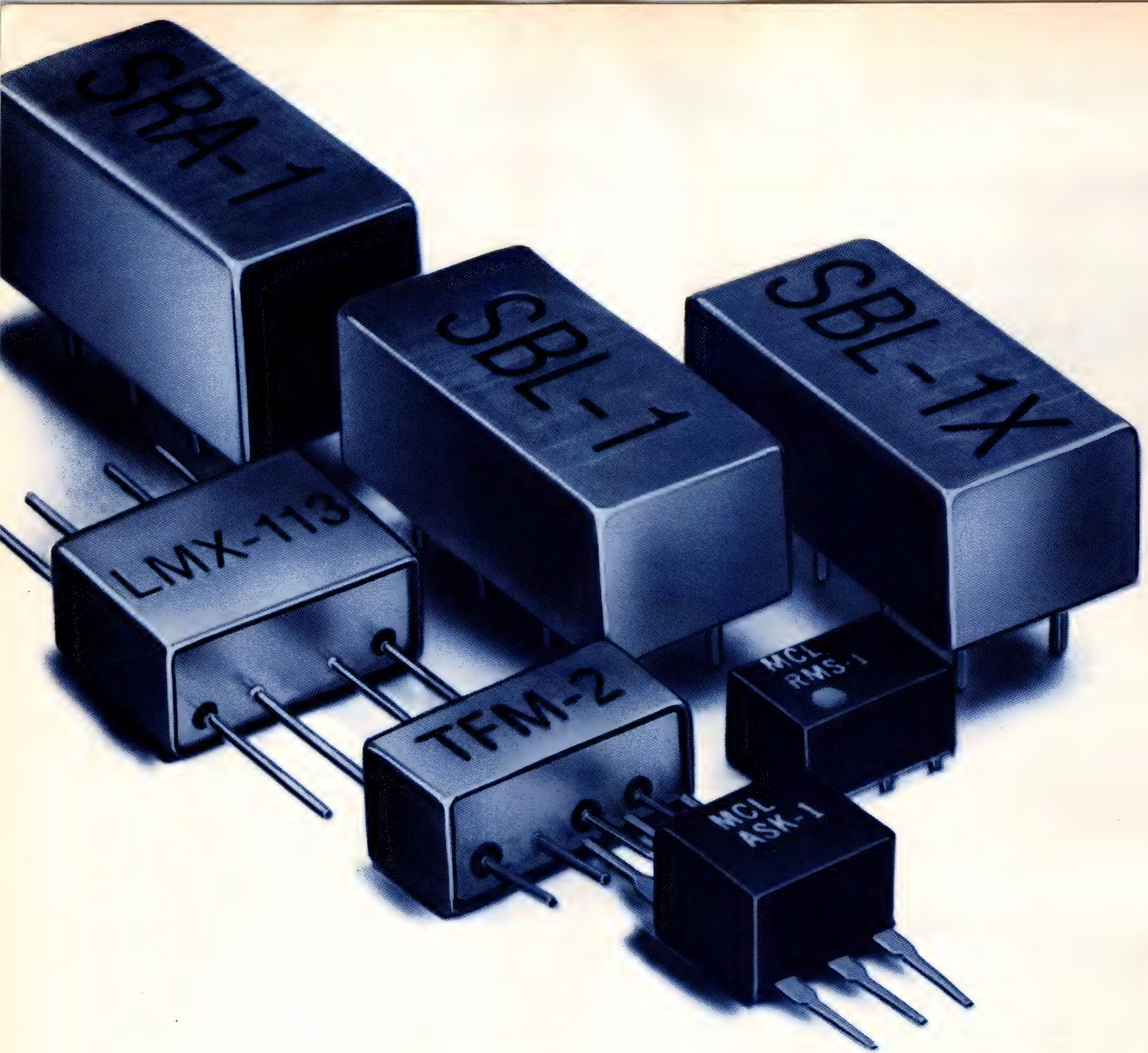
The industry's standard handbook on EMI, ESD, telecom and safety, Compliance Engineering 1987 covers specifications and methods of engineering for Safety, EMI, ESD, and Telecom compliance. With the need to comply with these specifications universally recognized, engineers have sought out, but been unable to find, authoritative sources for issues related to designing for compliance. Now in Compliance Engineering, separate sections covering EMI, safety, telecom and ESD give a step-by-step approach to control and

compliance. The 1985-86 edition drew rave reviews from its readers. You can receive the 1987 issue (available in January, 1987) free of charge just by circling the Reader Service Number below.

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TFM-2*	1-1000	6.0	40	11.95	(6-49)
SBL-1	1-500	5.5	45	4.50	(10-49)
				3.95	(100)
SBL-1X	10-1000	6.0	40	5.95	(10-49)
ASK-1	1-600	5.5	35	5.95	(10-49)
LMX-113*	5-1000	6.5	40	14.95	(6-24)
RMS-1	0.5-500	5.5	33	6.95	(10-49)

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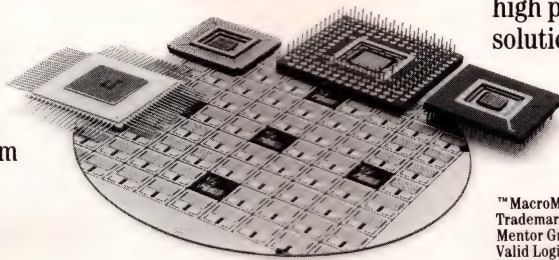
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Typical App.	Part No.	Number XMTRS	Number RCVRS	Shutdown Three-state	On-board Caps.	Number Pins	Price (100up)
Digital PBX Interface	MAX230	5	0	Yes	No	20	\$ 4.00
Peripheral Interface	MAX231*	2	2	No	No	14	2.52
General Purpose Interface	MAX232	2	2	No	No	16	3.60
Gen. Pur. Interface/ Space Saver	MAX233	2	2	No	Yes	20	6.75
+5V 1488 Replacement	MAX234	4	0	No	No	16	3.60
Synchronous Communications	MAX235	5	5	Yes	Yes	24	10.00
Battery Powered Equipment	MAX236	4	3	Yes	No	24	5.00
Modem Interface	MAX237	5	3	No	No	24	5.00
+5V 1488/1489 Replacement	MAX238	4	4	No	No	24	5.00
IBM® PC Compatible	MAX239*	3	5	Yes	No	24	5.00

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# SIGNALS & NOISE

## Teachers' unions and political activity

Dear Editor:

You published a letter by Mr Thomas Silhan in the August 21 issue of EDN (pg 30). He issued a stirring call "... to eliminate the left-wing political activity—as well as all political activity—of the teachers' unions."

He, and others of similar sentiment, would be well advised to study the multitude of governments, east and west, where this very objective has been achieved. The results are most unpleasant.

Sincerely yours,

Joel Leenaars

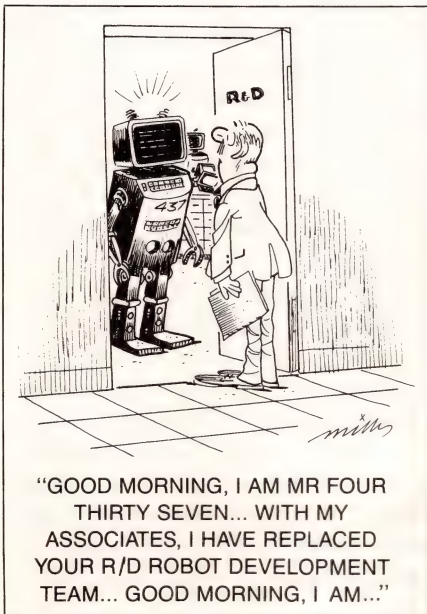
Impetus Inc

Richmond, CA

must occur in the programmer him/herself. Using good tools may in fact be the catalyst to such a conversion, and once the conversion occurs, CASE tools will prove as indispensable to the programmer as assemblers and compilers are now, but the tools alone will not be a panacea.

And I do completely agree with

your comments on creativity and disorganization. Most of the greatest creative geniuses worked closely with standards—Mozart comes to mind, or, more forcefully, Beethoven—both being constrained by standards and also redefining them. The quality of the output was in no way diminished. Real genius in any



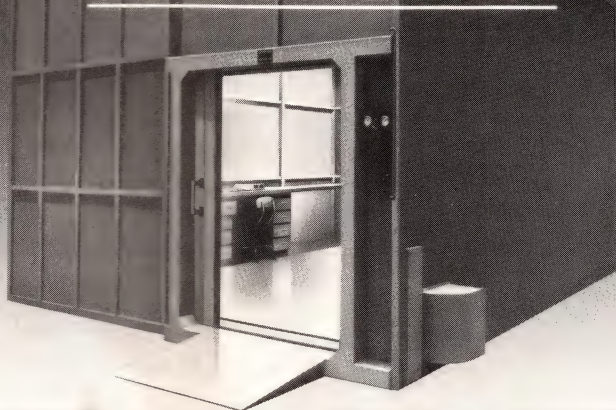
"GOOD MORNING, I AM MR FOUR THIRTY SEVEN... WITH MY ASSOCIATES, I HAVE REPLACED YOUR R/D ROBOT DEVELOPMENT TEAM... GOOD MORNING, I AM..."

## CASE tools supplement good programming methods

Dear Editor:

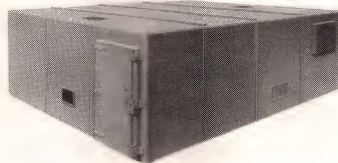
Concerning your editorial "Software creativity—discipline=a mess" (EDN, September 4, pg 47), good computer-aided software-engineering (CASE) tools *are* badly needed and will do much to reduce the high costs associated with software maintenance. However, such tools alone are insufficient. Ultimately, conversion to good (and always improving) programming techniques

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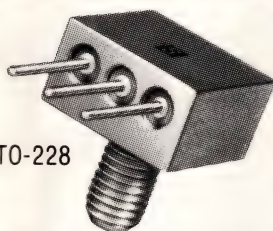
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SDT 55462	50	350	8/40	30	625
SDT 55464	50	400	8/40	30	625
SDT 55470	40	450	10/40	20	620
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## SIGNALS & NOISE

creative discipline has rarely been associated with lack of structure.

*Sincerely yours,*

*David I Brubaker*

*Brubaker Electronics Consultants  
Menlo Park, CA*

### Software puts MS-DOS in EPROM

Dear Editor:

In the otherwise informative article "Single-board computers support PC and PC/AT bus" (EDN, July 24, pg 64), the table on pgs 68 and 69 erroneously claims that the I-Bus F286 PC/AT-compatible single-board computer does not have a real-time clock. The F286 does have a real-time clock.

What's more important, the article appears to miss the point of the PROMdisk software package. What PROMdisk allows you to do is to put the MS-DOS operating system in EPROM to support user code. This capability allows you to use any compiler that will run on the PC to produce ROM-based code. Also, the \$1995 charge is a site license, not a per-unit charge; once a customer purchases PROMdisk, he can use it on as many units as he wants.

Finally, the last sentence in the article states that "the F286 board from I-Bus has the least amount of onboard RAM (256k bytes)" and that it furnishes a serial port. The F286 comes with 512k bytes of RAM and does not include a serial port.

*Sincerely yours,*

*John Swen*

*I-Bus Systems*

*San Diego, CA*

### WRITE IN

Send your letters to the Signals and Noise Editor, 275 Washington St., Newton, MA 02158. We welcome all comments, pro or con. All letters must be signed, but we will withhold your name upon request. We reserve the right to edit letters for space and clarity.

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2

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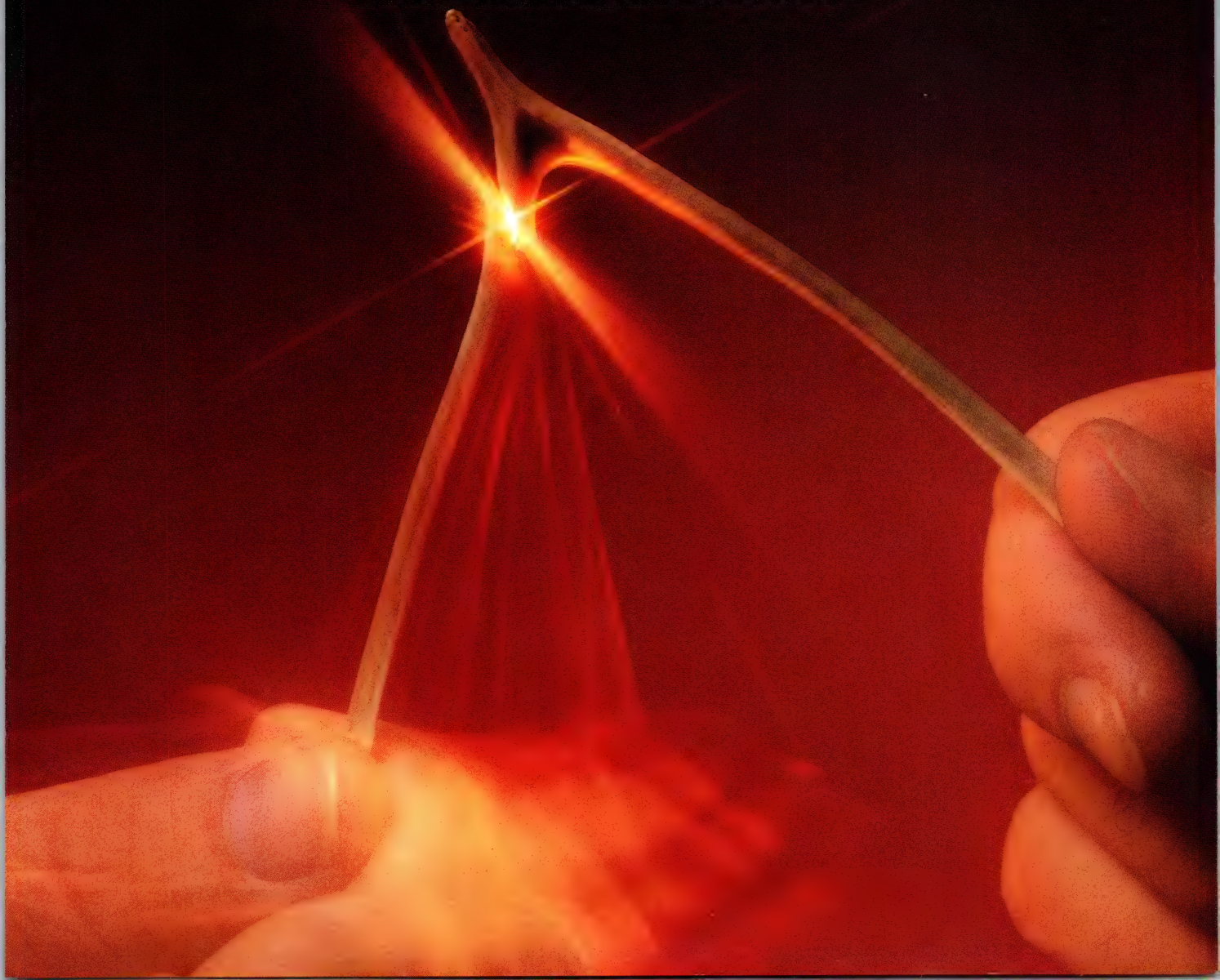
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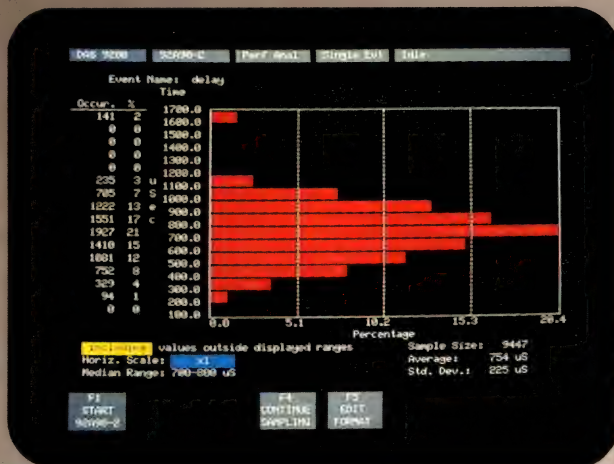
6

Functional board testing at an affordable price





# INTRODUCING THE DAS9200: NOW TEK MAKES THE IMPOSSIBLE LOOK EASY.



Software Performance Analysis, like this distribution of a subroutine's execution times, helps you easily understand the activity of your code.

Seq	Address	Data	Mnemonics	State
6597	main + 2F7C	4EB9	JSR ser_io	(U)
6791	ser_io + 84	61FC	BSR put_byte	(U)
6871	put_byte + 42	4E75	RTS	(U)
9600	ser_io + 1206	4EB9	JSR delay	(U)
11699	delay + 76	4E75	RTS	(U)
11796	ser_io + 1324	61FC	BSR com_tst	(U)
11899	com_tst + 76	4E75	RTS	(U)

Step backwards through acquired data, including sub-routines, stack and register models, using time-correlated split-screen displays to pinpoint problems.

In every dimension—speed, channel width, memory depth, trigger capability, modularity and ease of use—the DAS9200 dwarfs what's been possible before.

The DAS9200 features a tightly coupled, high-speed architecture in which multiple card modules can act as a single unit. Large color-coded displays, pop-up menus, performance analysis graphs, multi-tasking and more combine to uncomplicate logic analysis.

**1** Apply state-driven triggering at 200 MHz with up to 384 channels of sync and async data acquisition.

You can assurance-test high-speed logic at full speed, using 4-level state tracking and high speed counter/timers integrated into the 92A16 timing board.



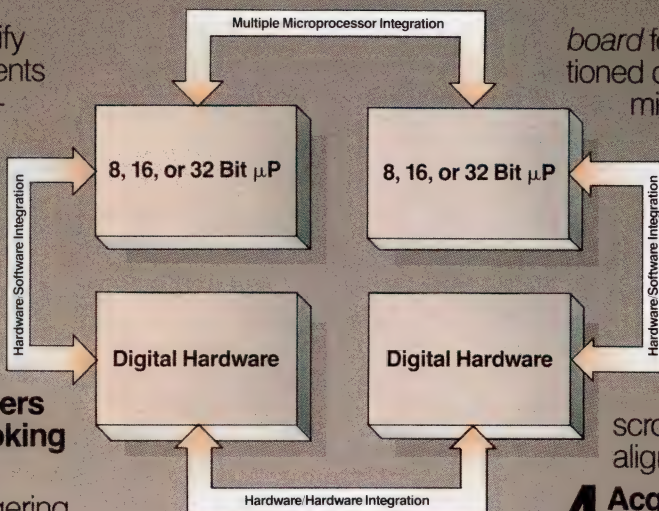


You can monitor and verify all the timing measurements in a circuit, including set-up and hold time, minimum pulse width, and precharge time, and quickly select common-test routines from the Trigger Library.

## 2 Register deduction and stack simulation let developers debug software by looking backwards in time.

Use the complex triggering, data qualification and 32K per channel memory of the 92A60/92A90 acquisition modules to monitor software activity in real time.

Continually updated register and stack displays let you quickly identify problems like stack overflow or incorrectly restored pointers—without



breakpoints and manual notation.

## 3 Split-screen time-correlated displays help you monitor and correlate up to six microprocessors at once.

Take the same system modules used in debugging the hardware and software and re-configure them *from the key-*

board for integrating partitioned designs or multiple microprocessors.

Use the dual time-bases and real-time handshaking between modules to set up split-screen displays of disassembly with timing or state table data. Lock the two cursors so that both screens scroll in precise time alignment.

## 4 Acquire up to 160 channels at a full 2 GHz for unprecedented 500 ps sampling.

The 9200 offers the first acquisition unit to split the nanosecond: the 92HS8. With its 500 ps sample interval and 1.5 ns glitch detection, you can identify previously undetectable race conditions, spurious clocks and setup/hold violations in any logic family.

The 92HS8 is complemented by the world's most advanced probing system, featuring an input capacitance of less than 1 pf.



Available in desktop and rack-mount versions, the DAS9200 mainframe can be augmented with up to three expansion mainframes for a total of 28 card slots.



# BENCHTOP ASIC OR PCB TESTS? YOUR WISH IS OUR COMMAND!

Cluster	Module	Pass	Origin	Name	read	nstat	ready	nstate
CURSOR	0000000000	1111011101	0	007352	0	0	0	0
1	001001111000	x0000000000	1	003552	0	0	0	0
2	101111011010	x0000000000	1	003552	0	0	0	0
3	100110100000	x0000000000	1	003552	0	0	0	0
4	111111110111	0	167950	0	0	0	0	0
5	001010001111	0	006422	0	0	0	0	0
6	110101111000	0	144036	0	0	0	0	0
7	000010011000	0	108560	1	0	0	0	0
8	101000101000	0	024363	0	0	0	0	0
9	111101111011	0	007352	0	0	0	0	0
10	001001011110	0	003552	0	0	0	0	0
11	111111011111	0	063576	0	0	0	0	0
12	000001111111	0	174191	0	0	0	0	0
13	111111111111	0	008270	0	0	0	0	0
14	110101111101	0	076263	0	0	0	0	0
15	101010101010	x0000000000	1	003552	0	0	0	0
16	111111010111	x0000000000	1	015301	0	0	0	0
17	101110101010	x0000000000	1	174735	0	0	0	0
18	111101111011	x0000000000	1	063277	0	0	0	0
19	111010101101	x0000000000	1	073575	0	0	0	0
20	111111000000	x0000000000	1	173533	0	0	0	0
21	111110010111	x0000000000	1	174224	0	0	0	0

Results of the ASIC prototyping system can be displayed in timing or state format, with differences from expected results clearly highlighted.

ID	Description	Status
21	Trigger if glitch occurs within time Y after A	
22	Trigger if glitch occurs within time Y before A	
23	Trigger on setup time violation, chan X w/respect to chan Y	
24	Trigger on hold time violation, chan X w/respect to chan Y	
25	Send a signal to another module	
26	Count occurrences of A	
27	Count occurrences of A or B	
28	Count occurrences of A and B	
29	Time between A and B	
30	Accumulate total time spent between A and B	
31	Store only on transitions	
32	Store only between A and B	
33	Store except between A and B	
34	Conclusive proof of hardware bug	
35	Trigger on intermittent setup time violation	
36	Device's favorite trigger spec	
37	Conclusive proof of software bug	
38	Store all invalid writes to Port A	

With the Trigger Library, you don't need to know the micro-processor microcode or the bits and bytes of trigger setup to tackle once-difficult problems.

## 5 The DAS9200 is available as a low-cost turnkey ASIC device verification system.

Featuring 50 MHz pattern generation, 8K bit vector depth, 1 ns edge placement and 0.5 V/ns slew rates, it is an accessible, easy-to-use alternative to centralized systems.

You can link to popular logic simulators, download test vectors, call up split-screen displays and analysis graphs, utilize multiple sets of patterns

and parameter sweeps, and display results in timing or state format, with anomalies clearly highlighted.

## 6 The DAS9200 frees circuit board functional testing from costly and complicated central test systems.


Configure up to 1008 channels of stimulus at 50 MHz with 8K bits/channel of pattern memory. Up to 540 channels of acquisition at 20 MHz with 32K bits/channel memory. Or many other combinations.

Time-correlated module interactions let you use data acquired by one acquisition or stimulus module to change the activity of another for more realistic conditional testing... all for under \$700 per I/O pin!

**Compare your wish list against the complete list of DAS9200 capabilities.** Contact your Tek sales engineer for the full story and the hands-on proof. Or call toll-free for more information.

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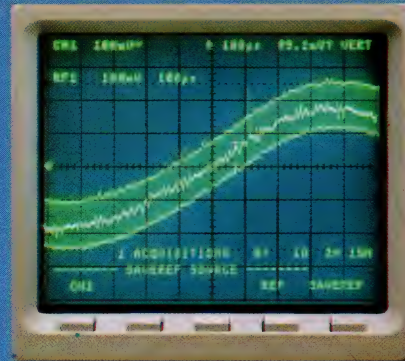
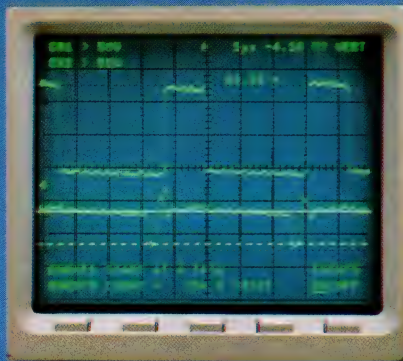
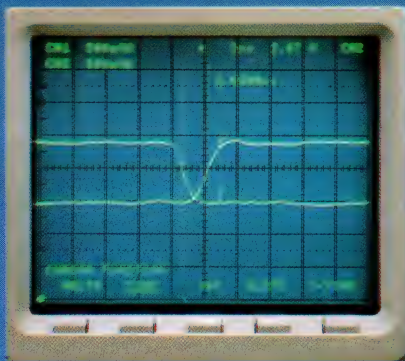
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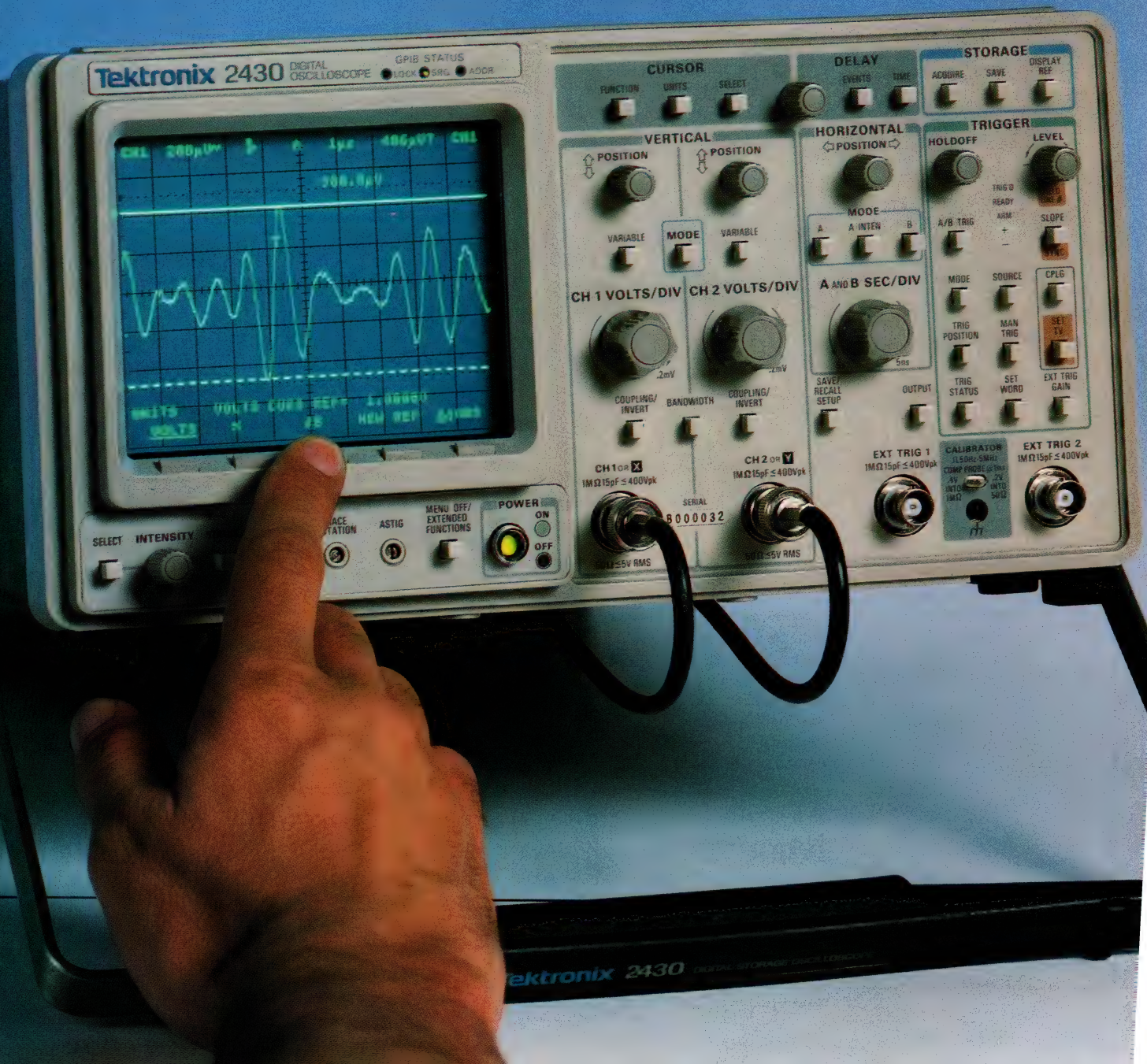




With its 150 MHz bandwidth, 5 ns/div maximum sweep speed and 2-channel simultaneous acquisition, the 2430 displays TTL and ECL signals for risetime and coincidence measurements. (Above) The scope is used in 50 ohm input termination with a 500 ohm probe for an accurate measurement of propagation delay through an ECL inverter.

How long does it take a transformer to reach operating voltage? Using DELAY BY EVENTS, the 2430 lets you select the 254th (or any other) switching event of the pulse-width modulator in a high-efficiency power supply.

A new Tek patented feature, SAVE ON DELTA instructs the 2430 to compare incoming acquisitions against a user defined reference and save it in the event of a difference. You can catch intermittent failures automatically and implement automatic tests with improved repeatability.





# TEK'S NEW 2430. THE REVOLUTIONARY DIGITAL SCOPE YOU ALREADY KNOW HOW TO USE.

**We've expanded the best features of our familiar, industry-standard 2400 Series in a new portable scope that sets some standards of its own.** Start with a 150 MHz bandwidth and a 100 MS/sec digitizing rate plus dual channel simultaneous acquisition. It's a powerful combination that enables you to digitize, view and store fast and complex signals.

Add 8-bit vertical resolution, 1K record length per channel and a 0.01% crystal-controlled timebase for making accurate measurements with ease.

The result: an advanced measurement package with many sophisticated capabilities built in especially for solving tough product design problems.

**All-purpose high performance at its affordable best!** The 2430 not only handily meets your general purpose measurement needs, it gives you a lot more. With digital

capabilities come powerful waveform manipulation functions ranging from waveform multiplication to high-resolution averaging.

It is also fully programmable via the GPIB. Complete talk/listen capabilities extend the scope's power and make it a valuable systems component for making automatic measurements. You can develop test procedures that can be used later on the manufacturing floor. Plus, the time-consuming task of waveform characterization, analysis and logging is simplified.

In addition, the 2430 can store waveforms and front panel setups in nonvolatile memory.

**The 2430 exhibits unusual power as a troubleshooting tool.** The patented peak detection circuit lets you capture glitches as narrow as 2 ns at any sweep speed with confidence—a level of performance available until now in only the most expensive instruments.

The 2430's envelope mode, which automatically captures and updates signal minimums and maximums, allows you to conveniently study signal variations such as jitter, drift and stability. It also monitors signal excursions outside user-defined limits.

Plus, a broad range of pretrigger selections available in all modes makes it possible to examine conditions leading up to an event. The crystal-controlled timebase allows you to delay by time and/or events for precise timing measurements in complex triggering modes. You can even trigger on digital words.

**Best of all, we've kept the 2430 easy to use.** From the simple, one-level menus for standard functions to the comfortable grouping of the front panel controls, the 2430 was designed to drive like the scopes you already use.

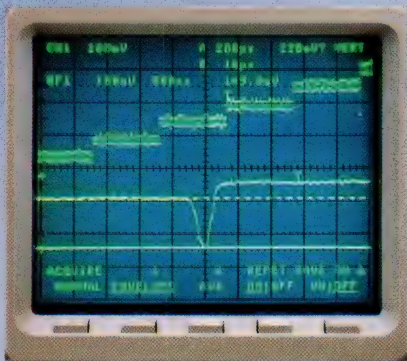


With full programmability you can improve repeatability and throughput—and reduce operator interface requirements.

The enhanced capabilities of the 2430's time and voltage cursors are another convenience, enabling you to make accurate measurements of all essential parameters.

**The reliability of the 2430 is underwritten with a 3-year warranty.** A variety of low-cost service plans can extend this coverage even further.

**Now! See the features you've been looking for in a priced-right, digital scope. Call your Tek sales engineer for a demo.** For literature, or to find our sales office nearest you, call the Tek National Marketing Center toll-free, 1-800-426-2200. In Oregon call collect, (503) 627-9000.



DAC glitches won't escape you with the 2430's enhanced ENVELOPE function. The peak-detecting ENVELOPE mode enables you to catch events as narrow as 2 ns, even with a single acquisition, at any sweep speed.

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# Cadnetix the standard C

## Finally, full-function CAE for your standard IBM PC.

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Finally, an experienced CAE vendor has outfitted an unmodified IBM PC/AT™ or XT™ with the same excellent hierarchical schematic capture tools included on our high-end workstations. We've given you immediate access to real CAE component and semicustom libraries via Ethernet™. And, we've made your PC a "window on the network," linking it to powerful Cadnetix engines for simulation, physical modeling and physical layout. All this without expensive alterations or add-on hardware. The Cadnetix PC System is a complete CAE resource that hasn't been converted into a high-cost hybrid.

## The super-computer power of Cadnetix Engines, directly available to your PC's.

With Cadnetix, your IBM PC becomes much more than a normal entry-level CAE workstation. For fast analysis of your largest designs, Cadnetix gives you direct access from your PC to our full line of CAE Engines.



You'll develop designs on the PC, then compile and analyze them on high-performance engines tailored for accelerated compilation, simulation, physical modeling and database management. And Cadnetix has integrated all of these functions into a single network resource featuring both a RISC processor and a bit-slice processor to accelerate various applications tasks.

Our Analysis Engine is a versatile processing node offering you the choice of configurations you need for your design analysis environment. With up to 280 Mb of disk, mass storage for database management is essentially unlimited. Options include:

- Bit-Slice Engine with Simulation: This bit-slice application-specific accelerator speeds through logic simulations at 200,000 evaluations per second — 200 times faster than typical workstations. Worst-case analysis tools are standard.
- GP Engine: A general purpose engine providing accelerated compilation and SPICE. Based on a RISC architecture chip set, it has an effective operating rate of 10 million instructions per second. In addition, a compiler and debugger tool set allow you to accelerate 'C' programs which you develop.
- Physical Modeling Engine: This engine simulates





# introduces AE workstation.

VLSI chips at vector rates of up to 16 MHz and accommodates devices with up to 364 inputs and 384 outputs. Vector storage of 512K x 91 bits provides for longer simulations and simultaneous analysis of up to 30 devices.

Powerful Cadnetix engines complement PC capabilities, achieving top efficiency in compute-intensive design tasks while supporting lowest-cost per engineer for routine access.

## **Now your PC has the capability of an entire design network.**

The Cadnetix PC System is not just another PC software package. It is your window to complete, supported solutions for electronic systems design.

The NFS® protocol, a powerful networking standard, provides immediate and transparent remote file access to our full range of design tools: PC's for engineering design, high-performance workstations



for advanced design tasks, high-capacity file servers for mass storage, engines for applications demanding peak power.

Cadnetix protects your investment with the most comprehensive set of data access standards available. With UNIX™ and EDIF, your data is always accessible. And with remote login capability, you can access any UNIX node on your network through the UNIX window on your PC.

Cadnetix has established the standard for ease of use with its industry-leading object-oriented user interface. Cadnetix has brought this interface to the IBM PC, giving you the shortest possible learning curve and eliminating a significant hidden cost of other systems.

Find out about the Cadnetix PC System. Discover the unlimited design potential of your PC.



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### **Solutions for system design.**

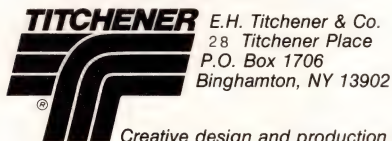
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# Free answers to your questions about defect-free wire forms

"Think Quality" explains Titchener's defect-free program for wire fabrications. If you recommend, specify or buy wire forms and welded wire assemblies, your homework's incomplete until you've read this pamphlet. It's free!



## Think QUALITY

Then call Titchener! 607-772-1161. Ask for Ralph Jones.

How to eliminate incoming inspection of wire forms and welded wire assemblies?

How does Statistical Process Control apply in low-volume situations?

How can Titchener help you determine critical dimensions?

Does "defect-free" go beyond the manufacturing floor?

## CALENDAR

**Invitational Computer Conference**, Irvine, CA. B J Johnson & Associates, 3151 Airway Ave, #C-2, Costa Mesa, CA 92626. (714) 957-0171. January 8.

**American Society of Test Engineers Annual Conference**, Anaheim, CA. ASTE, 114 N Hale St, Suite 2B, Wheaton, IL 60187. (312) 260-1055. January 8 to 9.

**Annual Battery Conference on Applications and Advances**, Long Beach, CA. Roseann Schaff-Matheny, Dept of Electrical Engineering, California State University, 1250 Bellflower Blvd, Long Beach, CA 90840. (213) 498-4605. January 13 to 15.

**PC Fab Expo**, Orlando, FL. PMS Industries, 1790 Hembree Rd, Alpharetta, GA 30201. (404) 475-1818. January 13 to 15.

**Buscon West** (Bus/Board Users Show and Conference), Los Angeles, CA. Buscon, 17100 Norwalk Blvd, #116, Cerritos, CA 90701. (213) 402-1610. January 20 to 21.

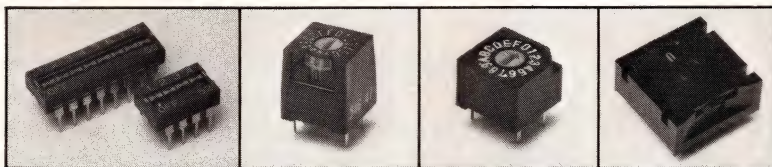
**Syscon** (Subsystems Conference and Exposition), Los Angeles, CA. Syscon, 17100 Norwalk Blvd, #116, Cerritos, CA 90701. (213) 402-1610; (714) 552-4617. January 20 to 21.

**Unix Technical Conference**, Washington, DC. Unix Association, Box 385, Sunset Beach, CA 90742. (213) 592-3243. January 21 to 23.

**Annual Reliability and Maintainability Symposium**, Philadelphia, PA. J L Rodriguez, Allied Bendix Aerospace, 15825 Roxford St, Sylmar, CA 91342. (818) 367-0111, x2276. January 27 to 29.

**ASEE** (Advanced Semiconductor Equipment Exposition and Technical Conference), Santa Clara, CA. Cartledge & Associates, 1101 S Win-

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CIRCLE NO 27



# MICRO CAP and MICRO LOGIC put your engineers on line... not in line.



## MY OWN WORKSTATION



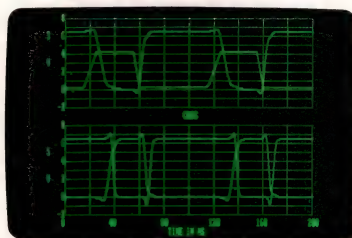
How many long unproductive hours have you spent "in line" for your simulation? Well, no more. MICROCAP and MICROLOGIC can put you on line by turning your PC into a productive and cost-effective engineering workstation.

Both of these sophisticated engineering tools provide you with quick and efficient solutions to your simulation problems. And here's how.

## MICROCAP: Your Analog Solution

MICROCAP is an interactive analog circuit drawing and simulation system. It allows you to sketch a circuit diagram right on the CRT screen, then run an AC, DC, or Transient analysis. While providing you with libraries for defined models of bipolar and MOS devices, Opamps, transformers, diodes, and much more, MICROCAP also includes features not even found in SPICE.

MICROCAP II lets you be even more productive. As an advanced version, it employs sparse matrix techniques for faster simulation speed and larger net-

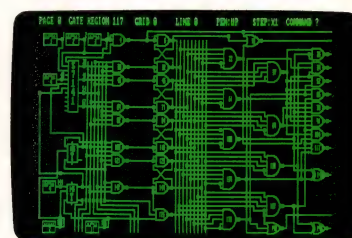


"Typical MICROCAP Transient Analysis"

works. In addition, you get even more advanced device models, worst case capabilities, temperature stepping, Fourier analysis, and macro capability.

## MICROLOGIC: Your Digital Solution

MICROLOGIC provides you with a similar interactive drawing and analysis environment for digital work. Using standard PC hardware, you can create logic diagrams of up to 9 pages with each containing up to 200 gates. The system automatically creates the netlist required for a timing simulation and will handle networks of up to 1800 gates. It provides you with libraries for 36 user-defined basic gate types, 36 data channels of 256 bits each, 10 user-defined clock waveforms, and up to 50 macros in each network. MICROLOGIC produces high-resolution timing diagrams showing selected waveforms and associated delays, glitches, and spikes—just like the real thing.



"Typical MICROLOGIC Diagram"

## Reviewers Love These Solutions

Regarding MICROCAP... "A highly recommended analog design program" (PC Tech Journal 3/84). "A valuable tool for circuit designers" (Personal Software Magazine 11/83).

Regarding MICROLOGIC... "An efficient design system that does what it is supposed to do at a reasonable price" (Byte 4/84).

MICROCAP and MICROLOGIC are available for the Apple II (64k), IBM PC (128k), and HP-150 computers and priced at \$475 and \$450 respectively. Demo versions are available for \$75.

MICROCAP II is available for the Macintosh, IBM PC (256k), and HP-150 systems and is priced at \$895. Demo versions are available for \$100.

Demo prices are credited to the purchase price of the actual system.

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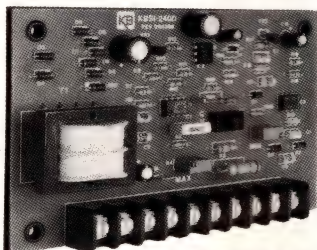
CIRCLE NO 29

# SIGNAL ISOLATOR

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- DC Drive
- Computer
- Controller
- Potentiometer
- Tachometer



Model KBSI-240D

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- Inverter
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CIRCLE NO 31

# CALENDAR

chester Blvd, M259, San Jose, CA 95128. (408) 554-6644. January 27 to 29.

**Computer Graphics New York '87**, New York, NY. Exhibition Marketing and Management, 8300 Greensboro Dr, Suite 690, McLean, VA 22102. (703) 893-4545. January 28 to 30.

**Invitational Computer Conference**, Fort Lauderdale, FL. B J Johnson & Associates, 3151 Airway Ave, #C-2, Costa Mesa, CA 92626. (714) 957-0171. January 29.

**Modern Electronic Packaging**, Orlando, FL. Technology Seminars, Box 487, Lutherville, MD 21093. (301) 269-4102. February 9 to 11.

**Invitational Computer Conference Computer Graphics Series**, San Jose, CA. B J Johnson & Associates, 3151 Airway Ave, #C-2, Costa Mesa, CA 92626. (714) 957-0171. February 10.

**Invitational Computer Conference**, Raleigh, NC. B J Johnson & Associates, 3151 Airway Ave, #C-2, Costa Mesa, CA 92626. (714) 957-0171. February 19.

**Invitational Computer Conference Computer Graphics Series**, Dallas, TX. B J Johnson & Associates, 3151 Airway Ave, #C-2, Costa Mesa, CA 92626. (714) 957-0171. February 24.

**Nepcon West**, Anaheim, CA. CEG, Box 5060, Des Plaines, IL 60017. (312) 299-9311. February 24 to 26.

**ISSCC (International Solid-State Circuits Conference)**, New York, NY. Lewis Winner, 301 Almeria Ave, Coral Gables, FL 33134. (305) 446-8193. February 25 to 27.

**West Lightwave Expo**, San Jose, CA. Lightwave, 235 Bear Hill Rd, Waltham, MA 02154. (617) 890-2700. February 25 to 27.



# Introducing OptiLab™

## The Complete Microprocessor Development Toolbox.

You need the right tools to speed completion of your project and improve its quality.

That's why we created the OptiLab toolbox. The tools you want for beginning-to-end development and optimization of microprocessor code. OptiLab's fully-integrated, PC-based system lets you debug, analyze, modify, optimize, and test code in a seamlessly integrated environment. You can add your own cross-assembler, too.

The star of the OptiLab is Program Performance Analysis that helps you uncover invisible bugs, eliminate unneeded code, and cure program inefficiencies. OptiLab runs in real-time, is non-intrusive, and gives you outstanding performance at a remarkably low price.

There's more. OptiLab's 48-channel analyzer lets you track bus state activity and trap bugs fast. Monitor your software as it executes in real time with

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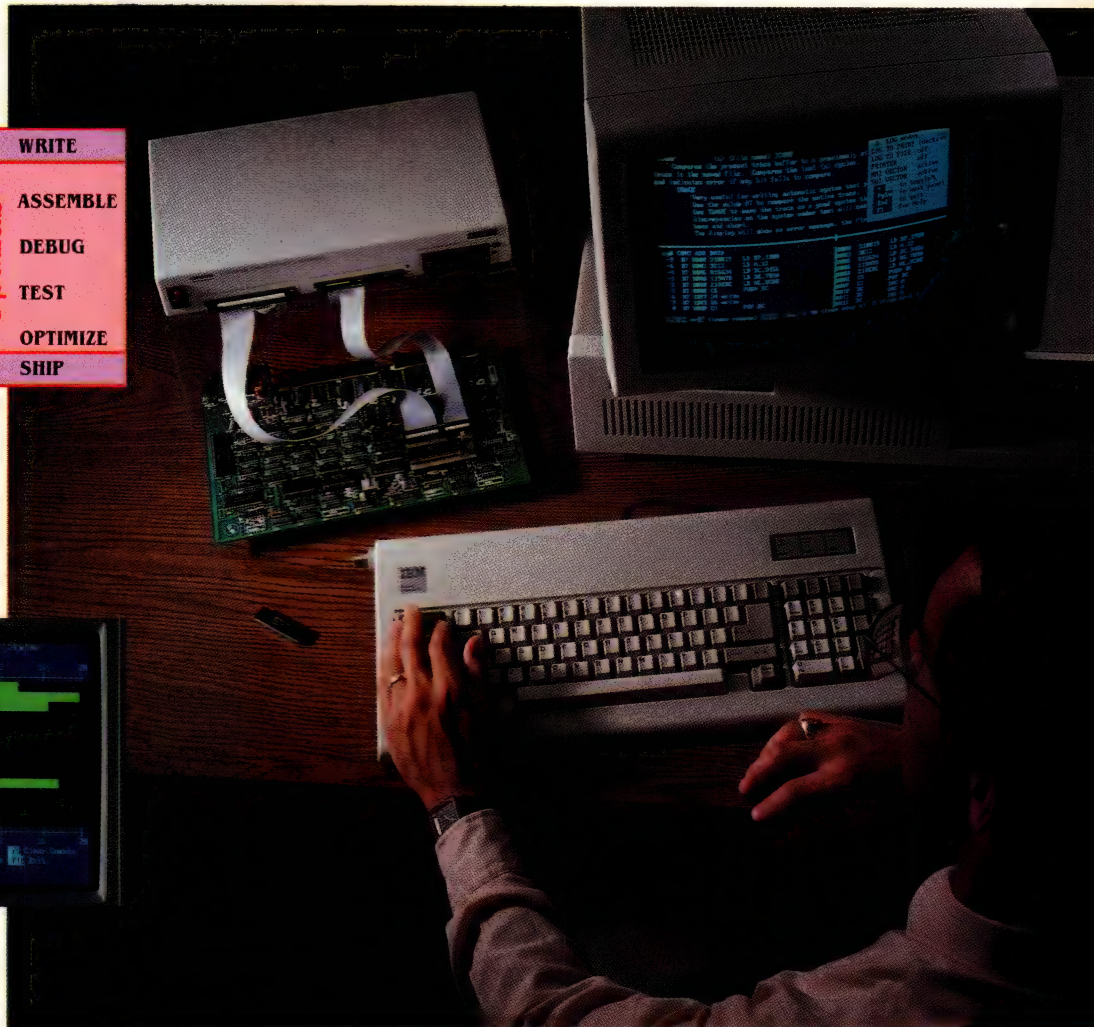
Call now for complete information on OptiLab or other Orion microprocessor development tools. All Orion products are sold with a 15-day money-back guarantee.

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Line-by-Line Assembler	
Debug Package	DEBUG
Performance Analyzer	
Stimulus Generator	TEST
EPROM Programmer	OPTIMIZE
	SHIP

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## Introducing the HP 54111D 1 gigasample/s digitizing oscilloscope, with 250 MHz single-shot and 500 MHz repetitive bandwidth.

The HP 54111D digitizing oscilloscope is the first HP scope to bring you a 250 MHz single-shot bandwidth (at 1 gigasample/s), *plus* a 500 MHz repetitive bandwidth.

It's loaded with hot features: simultaneous two-channel capture. A full 8K of memory per channel. Up to 8 bits of vertical resolution. And all the advantages of HP digitizing technology, including automatic answers, one-button hard copy output, digital storage, and HP-IB programmability.

The HP 54111D has the blazing speed to capture elusive glitches that can plague logic and high-speed serial communications designs, and doubles as a great general-purpose scope for almost any R&D, design, or production test application.

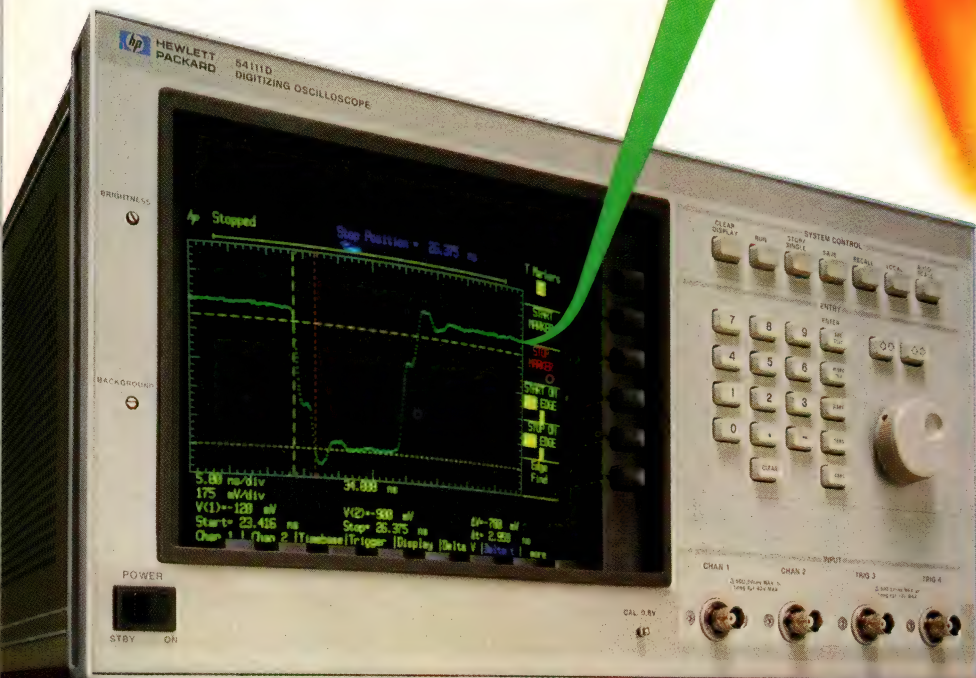
*Plus* it offers you the exceptional reliability you've come to expect from HP scopes, and extended warranty coverage as well.

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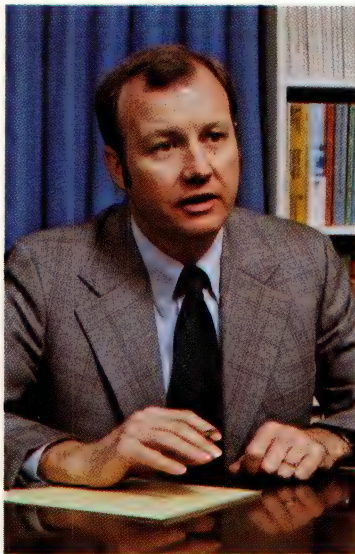
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PACKARD**

CIRCLE NO 34



# EDITORIAL

## Youngsters deserve a look at engineering



It's time to tell more young people, particularly those in high school, about engineering careers. By failing to teach more students about engineering, we miss opportunities to attract people to interesting and rewarding careers. All too often students drift into engineering because they're good in math and science, or because someone they admire is an engineer. A realistic exposure to engineering and its rewards might strengthen a high-school student's resolve to spend four years in a tough academic program. Such an exposure also risks turning away some youngsters who might otherwise study engineering. However, the gains outweigh the risks. We all benefit by putting students on paths to careers they'll enjoy, whether or not the careers are in engineering.

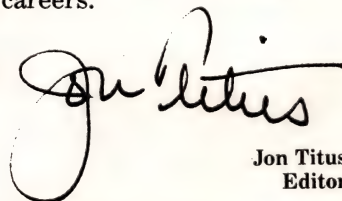
Before they consider an engineering career, young people deserve a look at the materials and products of engineering beyond the obvious examples of computers and VCRs. Because our electronic-industry trade shows feature a wide assortment of such products, let's consider opening the displays to youngsters. Show sponsors can admit organized high-school groups for a tour on one afternoon. We can start by admitting students from a few local schools that surround the show site.

Electronics exhibitions can't show every aspect of engineering, but they offer realistic information that kids can't get from guidance counselors or advisors. The Japan Electronics Show in Tokyo admits the public free of charge on two days. Attendance is high, and many young people are in the crowd. Such open attendance costs exhibitors more, but Japanese companies think the long-term benefits are worth the price.

Besides opening Wescon, Electro, and other US trade shows to high-school students, there is more we can do. Many schools sponsor a career day during which adults talk about their professions. You can volunteer to give a presentation about electrical and electronic engineering. If your local school doesn't sponsor a career day, offer to talk to individual classes about what engineers do and what career opportunities they have.

Be sure the local schools know about the plant and lab tours your company offers. If tours aren't available, ask your company's public relations department to consider them. Consider involving your local IEEE section in science fairs, ham-radio clubs, scout troops, and other activities at local schools. Although the IEEE sponsors student papers and competitions for college students, it does little to promote engineering careers to high-school students.

To keep our profession active, we need a steady supply of vital, eager newcomers. It's time to renew our efforts to reach youngsters and instill an interest in engineering careers.

  
Jon Titus  
Editor



# DIGITAL SIGNAL PROCESSING:

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The shift from analog to digital signal processing (DSP) is one of the most powerful technology trends of the 80's. And NEC is leading the way. With a full spectrum of DSP solutions for voice, image, and data applications. Solutions that give you flexibility, programmability, stability against temperature variations, and immunity to noise.

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Get more out of your modem with NEC's 7720A. The industry standard data transmission device, now in a new low-power version. It's also great for touch-tone decoding, echo cancellation and instrumentation.

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### **Image Processing Break Through**

NEC's 7281 is a real breakthrough in image processing. Using MIMD (multiple instruction, multiple data streams) and a true data-flow architecture, the 7281 roars through image processing tasks at an incredible 5 MIPS per device. Teamed with its MAGIC Interface chip, NEC's Image Pipelined Processor can give you size/cost savings of 100 to 1.

### **The Next Generation**

While meeting your current needs with the full spectrum of DSP solutions, NEC is opening new technological horizons. In 1986, we'll make a major announcement that will take digital signal processing into the next generation.

### **Call Toll Free Today**

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### **NEC's Full Spectrum of DSP Solutions**

Device	Description	Application	Remarks
7720A	General Purpose DSP	Data modems, DTMF, instrumentation	New low-power version
7730	Speech Encoder/Decoder	Voice store and forward; voice mail	16-32 KBPS
7756	Speech Synthesizer	Voice Response	High-quality voice reproduction
7281	Image Pipelined Processor	Image processing and general-purpose DSP	True parallel processing, non-von Neumann architecture
9305	Memory Access and General Bus-Interface Chip (MAGIC)	Interface device for 7281	Contains all basic circuits required to implement 7281 system

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Most of the major vendors of CAE/CAD technology for electronics will be on hand, and we think you'll find them quite responsive. The whip crack of market pressure has suppliers acknowledging your call for practical, integrable tools... which are just what you'll see! You can also take advantage of our conferences—a user-oriented program tied closely to the exposition. Like everything at ADEE, it's designed to make your encounter with the technology predictable and cost-effective.

Want to see IC and PC Layout tools interface without the semblance of a scuffle? Care to witness the graceful leap of a circuit design from pure concept through final output? These are just a couple of the feats you'll view at CIRCUITPATH. It's a working, multi-company, circuit design system demonstration, but more than that, too. It's proof: working proof that a complete system is possible today and proof that there are real end-to-end solutions out there. Just take hold of the leash.

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**A1**





# For more confidence in your scope measurements...

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No. 2 in a series.

# Explore HP Digitizing Oscilloscopes.

## Digitizing technology provides a highly accurate display of your signal.

Unlike their conventional analog counterparts, digitizing oscilloscopes are *quantitative* measurement instruments that capture and quantize input signal information. This gives a more accurate picture of a signal than an analog scope's trace. While analog scopes provide a good *qualitative* look at signal behavior, digitizing scopes do more... letting you pinpoint causes of the behavior and more precisely measure and analyze captured information.

### Display accuracy comes of age.

HP designed the HP 54000 series digitizing oscilloscopes for greatest possible accuracy of displayed information. So you can use them with confidence, even in measurement reference applications. That's because nonlinearity, distortion, drift, and jitter common to analog scopes aren't a problem with our digitizing scopes. Neither is blooming or fading of traces. What you see on the display is the clearest, most accurate representation of your signal.

### Elusive glitches easy to find.

Finding infrequent, fast glitches in digital circuits is tough enough. When the glitch is superimposed on normal data with a high duty cycle, it's nearly impossible. HP's new digitizing scopes solve this problem by letting you retain glitches, worst-case conditions, or metastable states on the screen indefinitely and view them right along with normal trace data.

Events that would be hard or impossible to find with an analog scope can be isolated and retained

while you're away from your digitizing scope; precisely quantified; saved in memory for later analysis; or recorded on a printer or plotter.

### Capture pre-trigger events.

With digitizing scopes, you can see events *before* as well as after the trigger. This is highly useful in finding the cause of undesired or unusual events in various types of circuits—and absolutely critical when measuring setup time on logic ICs.

### Find signals buried in noise.

Digitizing scopes let you take signals from uncorrelated noise and measure them accurately. Analog scopes can sometimes reduce noise, but not without removing high-frequency information and adding phase shift. The averaging function in HP digitizing scopes won't distort the signal, or remove or add any information.

### Color enhances confidence.

The multiple-color capability found in the HP 54110D and the HP 54111D digitizing oscilloscopes makes using your displayed information easier. For instance, you can clearly distinguish channel one information from that of channel two, even when your signals overlap and both have multiple levels, jitter, and noise.



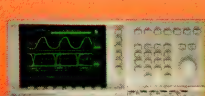
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HP-IB: Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a measurement system.

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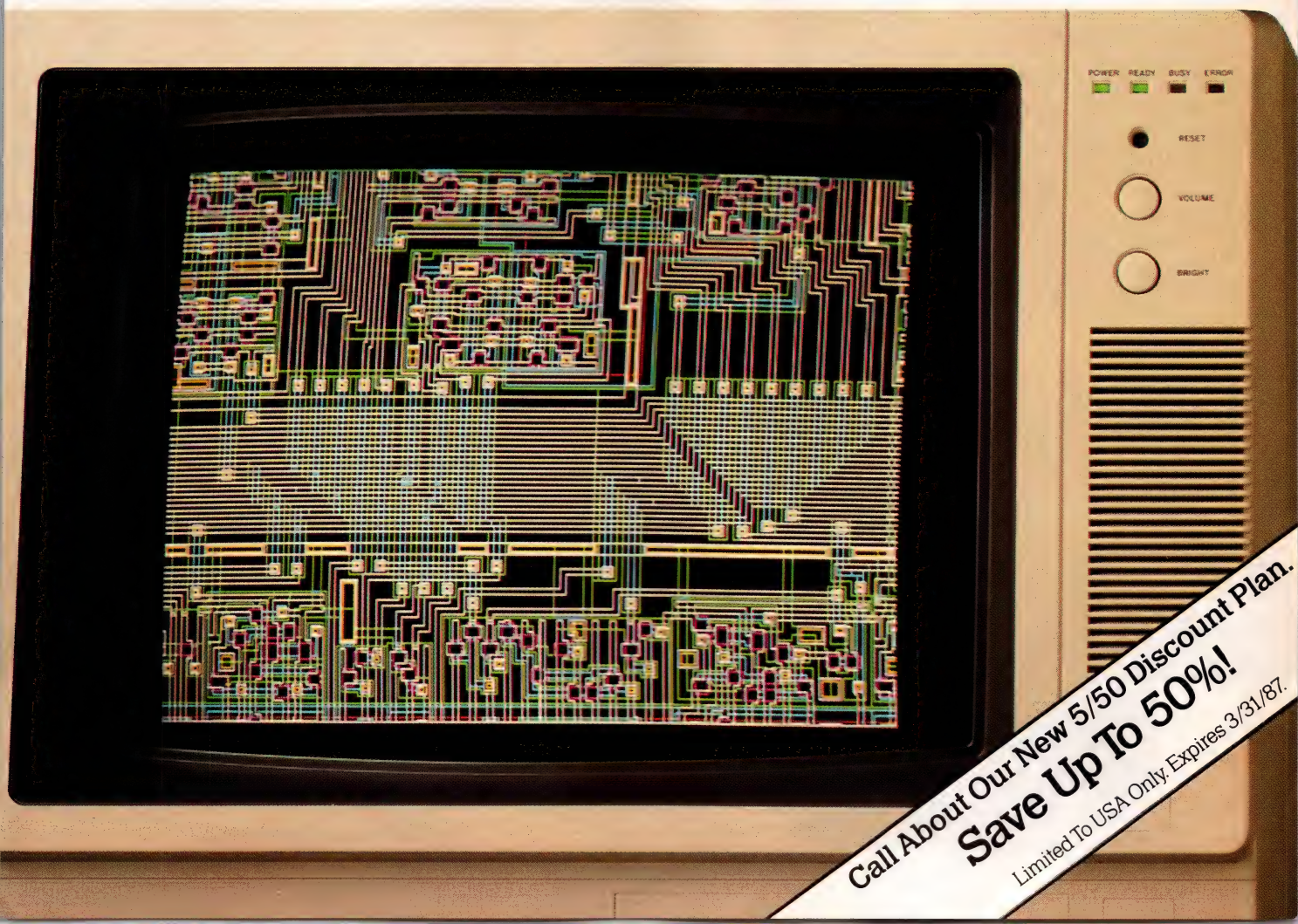
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INSTRUMENTS

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CIRCLE NO 37

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**CIRCLE NO 36**



## PRODUCT UPDATE

# CMOS 1M-bit static-RAM module fits into 32-pin DIP

Although 1M-bit monolithic static RAMs may be a year or more off, you can specify a hybrid equivalent today. For example, the DPS41288 family of static RAM modules features 1M bit organized as 128k bytes. The modules fit into the JEDEC-standard package for 1M-bit static RAMs—a 32-pin DIP. Furthermore, you can choose versions having access times ranging from 70 to 150 nsec, and you can obtain military versions of the product.

Each DPS41288 module carries four 32k-byte static RAM ICs and one decoder. The modules operate from single 5V supplies; all inputs and outputs are TTL compatible. The modules also have a data-retention voltage of 2V, and they feature common I/O. An output-enable pin permits you to OR-tie the modules.

The static RAM hybrids' operating power consumption is 330 mW max. The hybrids consume relatively little power because only one of the four chips is active at any one time. In standby mode, a module typically draws only 10  $\mu$ A.

You can specify the 1M-bit modules in versions offering access times of 70, 100, 120, or 150 nsec. The substrate, a ceramic-alumina substrate with low capacitance and good heat-dissipation qualities, contributes to the modules' high access speed. For example, the data-I/O lines specify a maximum capacitance of 45 pF, and address and control signals typically reduce that figure to 30 pF.

You can also choose from a number of operating-temperature versions. The commercial-grade offerings operate from 0 to 70°C. Industrial-grade parts stretch the operating range to -40 to +85°C

and feature factory burn-in. Military-grade modules operate from -55 to +125°C, and you can specify modules that comply fully with MIL-STD-883C.

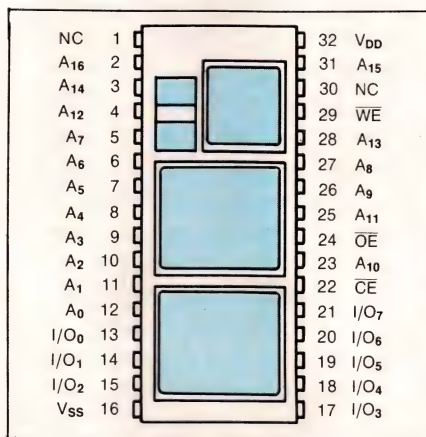
Full compliance with MIL-STD-883C means that the static-RAM chips used also comply with the standard and that the chips are traceable to a certified MIL-STD-883C source. (For projects that require MIL-STD-883C parts, you must specify fully compliant parts, and not merely parts screened to the spec.)

A 55-nsec version of the static-RAM module will be available in the first quarter of 1987. All other DPS41288 modules are available now. The DPS41288-150C, a 150-nsec commercial version, costs \$295 (100). The company also plans to offer an EEPROM in a similar configuration after the first of the year.

—Maury Wright

*Dense-Pac Microsystems Inc.,  
7321 Lincoln Way, Garden Grove,  
CA 92641. Phone (714) 898-0007.*

Circle No 725

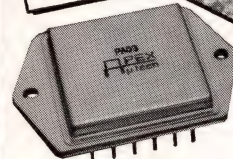


*The 1M-bit static RAM module, Model DPS41288, features 128k-byte organization and comes in commercial, industrial, and military grades, and also in military grades certified to MIL-STD-883C.*

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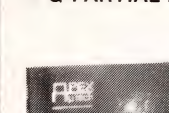
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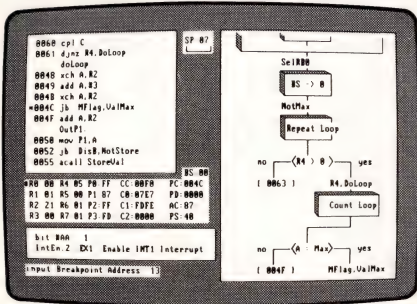
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CIRCLE NO 38



# IBM-PC based microcomputer development tools!



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**8051**

**8049**

**7000**

**8088**

**8085**

**320**

**Z8**

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	DEBUG	XASM	PROG
8096	✓	✓	✓
8051	✓	✓	✓
8049	✓	✓	✓
7000	✓	✓	✓
8088	✓		✓
8085		✓	✓
320		✓	✓
Z8		✓	✓
	\$595 except 8096 and 8088	\$295	\$245 Kit form

debug demo diskette and manual only \$39.50



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CIRCLE NO 39

## PRODUCT UPDATE

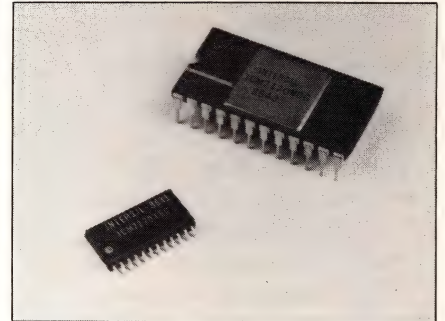
### CMOS clock/calendar IC meets MIL-STD-883C Rev C

The CMOS ICM7170 real-time clock chip furnishes either a 12- or 24-hour time in an 8-bit binary format over the full military temperature range ( $-55$  to  $+125^{\circ}\text{C}$ ). The part measures time in increments of 10 msec for periods as long as 99 years, with typical timing accuracies on the order of 1 ppm, depending upon the stability of the external crystal oscillator.

You can program the ICM7170 to work in a standard Pierce oscillator configuration with any of four readily available crystal frequencies—4.194304 MHz, 2.097152 MHz, 1.048576 MHz, or 32.768 kHz. An automatic, full-calendar leap-year correction algorithm makes the ICM7170 suitable as a clock standard in computer designs ranging from PCs to mainframes.

The part's internally latched 8-bit bidirectional data bus minimizes software driver code by ensuring that rollover doesn't occur during a read operation. Actual time values are accessed via a 5-bit address bus. Maximum read access time is 300 nsec, which is usually fast enough to eliminate wait states. An address-latch-enable (ALE) pin permits interfacing of the ICM7170 with multiplexed bus architectures.

The part's alarm and periodic interrupt functions make it suitable for such applications as task scheduling or controlling software diagnostics, or even for use as a watchdog timer. By programming its 51-bit internal status register, you can make the ICM7170 supply your CPU with either a preset alarm interrupt or periodic heartbeat interrupts at six different intervals, ranging from once every 10 msec to once per day. An internal diagnostic test mode, which speeds up the internal count by a factor of 100 $\times$ , lets you check alarm interrupt settings.



*Featuring on-chip battery management, the low-power CMOS ICM7170 clock/calendar chip is supplied in both a 24-pin cerdip military version and a 24-pin small-outline-IC version for industrial/commercial applications.*

An additional feature, the interrupt source pin (#11), lets you OR the interrupt output of the ICM7170 with other interrupt generators in more complex computer systems.

To simplify battery-backup designs, the device has an on-chip power-down detection circuit that shifts operation to standby mode when the threshold voltage falls below 1V. In this power-down standby mode, the typical supply current is only 20  $\mu\text{A}$  at 4 MHz. The ICM7170A version has a guaranteed standby supply current of 4 $\mu\text{A}$ . Because of its CMOS construction, the ICM7170 requires just 2 mA max from a 5V supply under normal operating conditions.

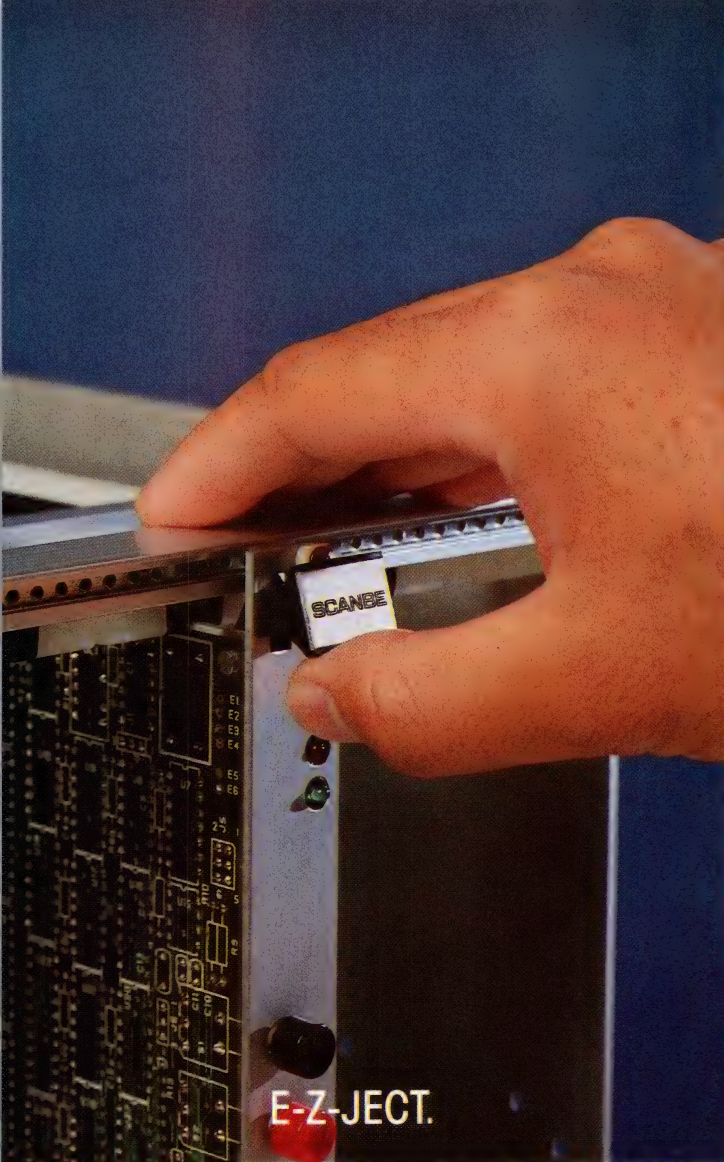
The ICM7170MDG/883B Rev C version, which comes in a 24-pin cerdip, costs \$27.90 (100). Commercial-grade versions in cerdips and plastic DIPs cost \$11.16 and \$7.50 (100), respectively. You can also get the part in a 24-pin small-outline-IC version for surface-mount boards for \$7.50 for the -7170IBG and \$9 (100) for the -7170AIBG.

—Denny Cormier

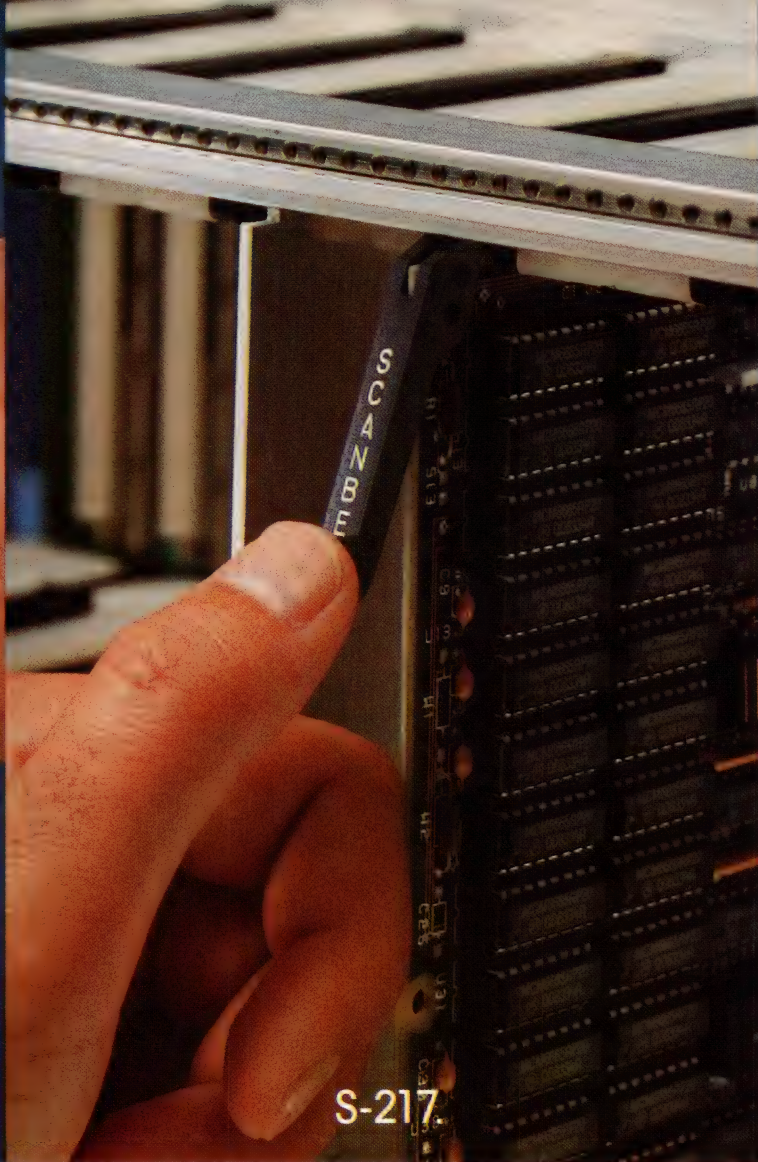
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Circle No 726





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**S-217.**

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Scanbe has two fixes for the problem. Pick one or the other, or both, depending upon your packaging situation:

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**S-217** is an injector/ejector system that gives you a lot of leverage—about 3.5 to 1—for the easiest

insertion and ejection of cards without front panels. It's a great help for 6U cards and it's the ultimate answer if you're using 9U cards. (If you're using Euro-cards, you should be talking to us about our versatile standard and mixed-height Eurocard cages.)

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**SIEMENS**

# Transmitting and Receiving with a Fiber Optic System

## Optical Transmitter/Receiver Family for 0 to 200 MBd – a Leading Light in Fiber Optics

For many years now, Siemens has been putting its extensive know-how into researching and refining the infant technology of fiber optics.

The result: user-oriented solutions, tailored to every sector and application. These solutions are available as complete systems or as tiny discrete devices for connecting, converting, transmitting, receiving, switching, branching, coupling or mixing.

One highlight of this development is the optical waveguide transmitter/receiver family for modulation rates of up to 200 MBd. This family has a multitude of transmitter and receiver modules to suit your application. Which transmitter/receiver combination is the right one for your application depends chiefly on two factors:

### Modulation rate and range

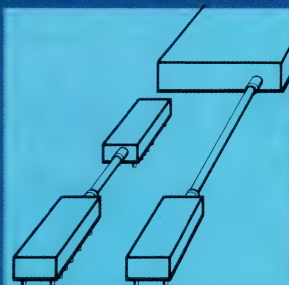
The illustrations show some possible applications and combinations of our optical transmitter/receiver systems.

### Shining Examples on the Railways and at the Post Office

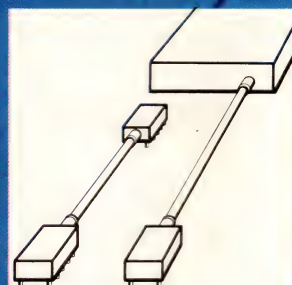
In its cabin signal and interlocking systems the German Federal Railway uses the 10-MBd system for absolutely interference-free, precise signal transmission.

In subway networks inter-computer links requiring a minimum of maintenance are made via the 50-MBd system.

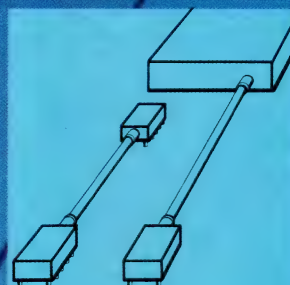
To improve telephone transmission quality and capacity, the German Bundespost employs the 170-MBd receiver module on long-haul routes and on surface cable installations in the Alps.



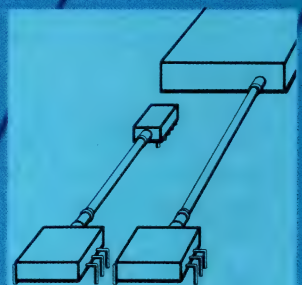
**Transmission system for 0 to 10 MBd**  
Range with LED: about 4 km  
Range with laser: about 40 km



**Transmission system for 5 to 50 MBd**  
Range with LED: about 2 km  
Range with laser: about 20 km\*  
\* under development



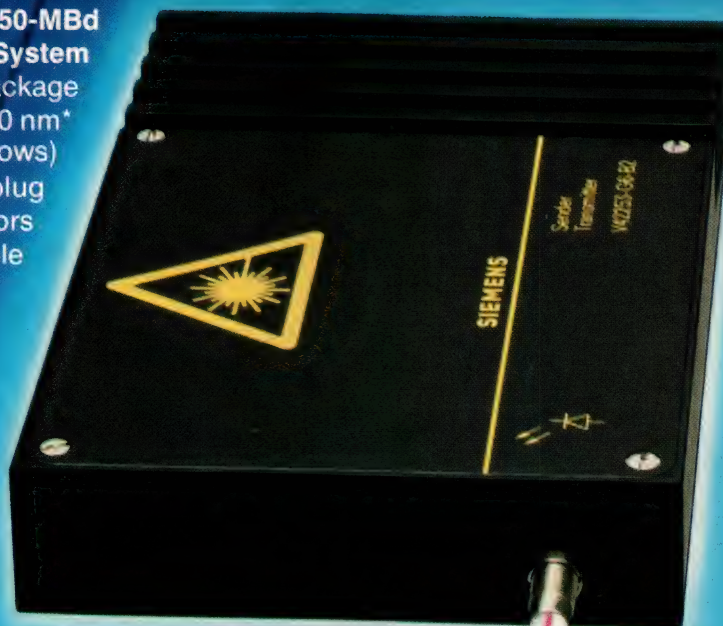
**Transmission system for 10 to 130 MBd**  
Range with LED: about 4 km  
Range with laser: about 30 km



**Transmission for 2 to 170 MBd**  
Range with LED: about 4 km  
Range with laser: about 30 km



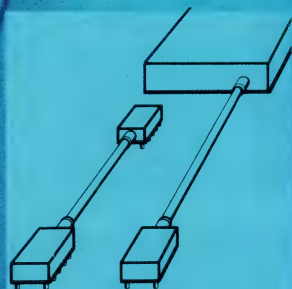
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Plastic dual in-line package  
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Range  
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Range  
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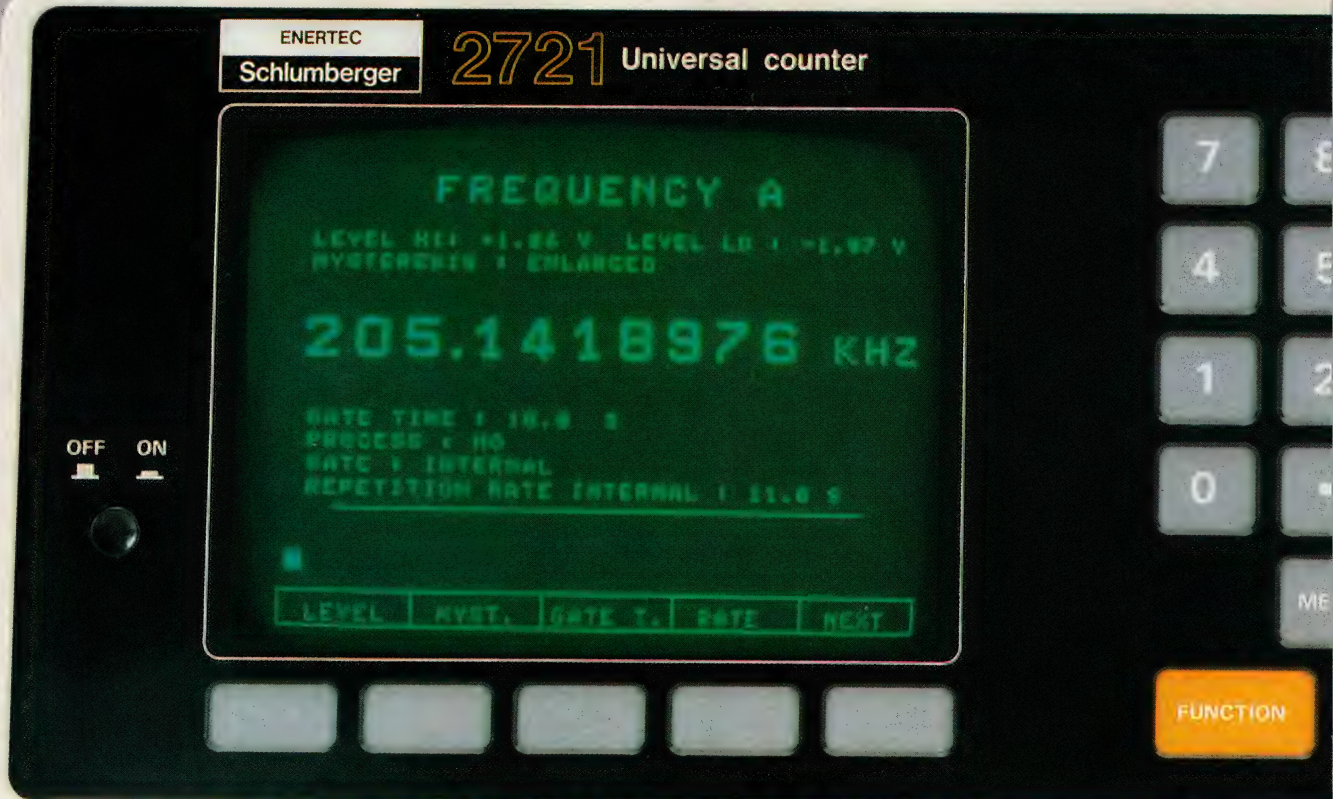
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**new**

# Enertec Instruments



## With a view



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Using the new "WAVEFORM" function, the 2721 universal counter/timer gives a graphic picture of the signal. Thus, the counter is no longer "blind", and the user has a better knowledge of the signal. In addition, a magnify feature makes signal analysis far easier.



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Introducing a CRT into the counter allows a "menu" technique to be used with soft keys. With this approach the user keeps direct control of the input system. He can select the active slope, the attenuator position, the filter, the input impedance, the common inputs, or increment the trigger level via the dedicated keys.

## 2721 universal counter.

**ENERTEC**  
**Schlumberger**

### Enertec Instruments

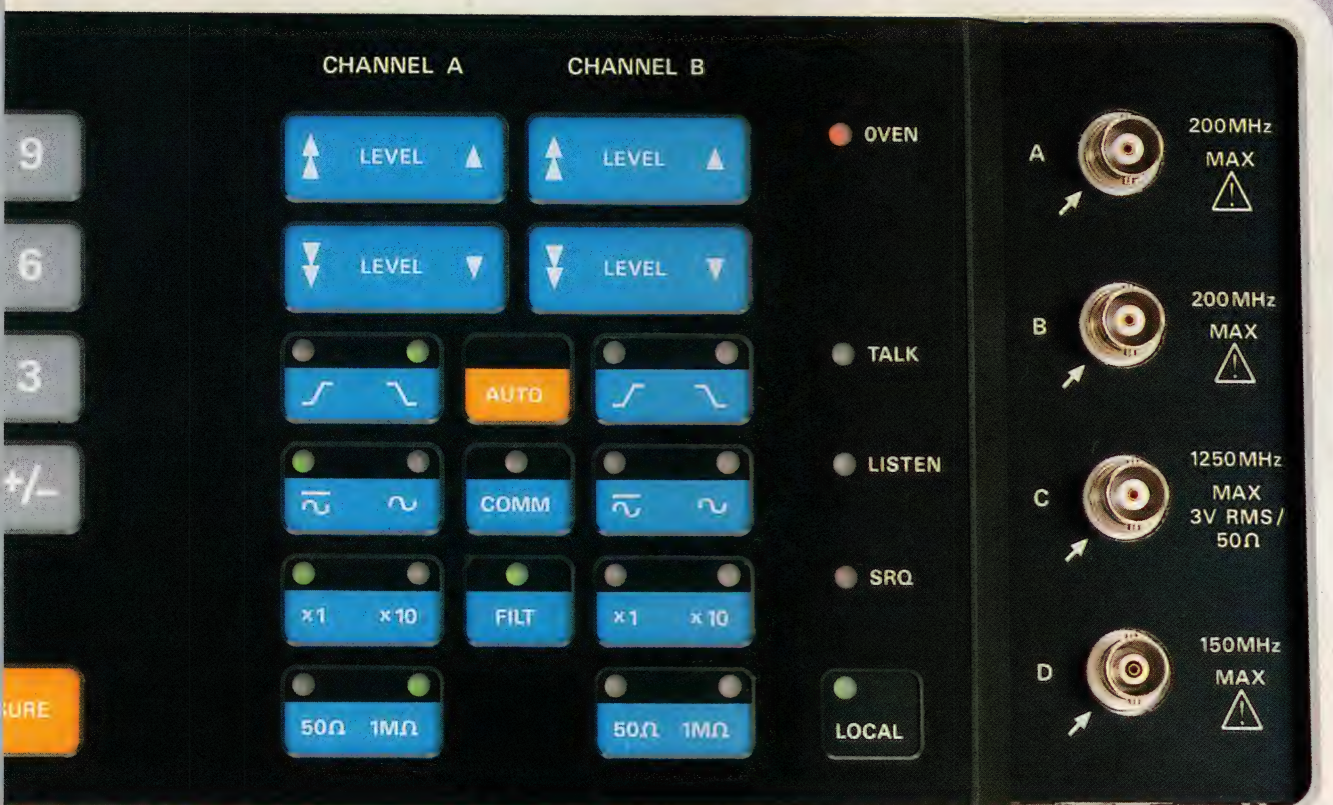
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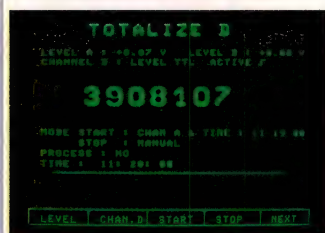
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# Solartron Instruments



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n a class of its own.

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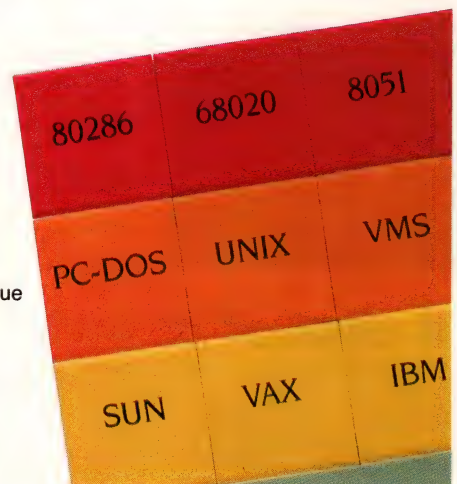
80286, 80186, 80188, 8086, 8088, 68000, 68010, 68008, Z80, NSC800, 8085, 6809, 6809E, 6502 (40 and 28 PIN) 8032, 8051, 8031, 8344, 8048, 8049, 8050, Z8, SUPER 8

The Intel 32-bit 80386 microprocessor has arrived, and is set to play an important role in high-end, high-performance products. Due to wider buses and higher clock speeds, complex 80386 target systems now require more powerful developing and debugging tools. Selection of a good development system and emulator will be critical in determining whether or not 80386-based products are completed on schedule and within budget.

MICROTEK'S U.S. service, sales and marketing arm, NEW MICRO, now has the MICE-32/80386, a portable emulator that can run with any IBM-PC/XT/AT personal computer or compatible, VAX, and MicroVAX through parallel or serial interface. Or can stand alone with a terminal.

## NMI

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# READERS' CHOICE

Of all the new products covered in EDN's **October 2, 1986**, issue, the ones reprinted here generated the most reader requests for additional information. In case you missed them the first time, find out what makes them special: Just circle the appropriate numbers on the Information Retrieval Service card, or refer to the indicated pages in our **October 2, 1986**, issue.



## ◀DISK DRIVE

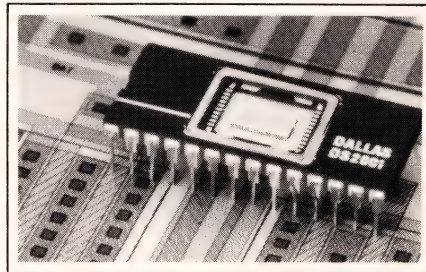
The EXT-8000 family of 5 1/4-in. Winchester disk drives includes ESDI or embedded-SCSI models and versions that store 760M bytes (pg 122).

**Maxtor Corp.**  
Circle No 351

## MEMORY IC ▶

The DS2001 2k×9-bit FIFO memory IC is dual-ported for simultaneous reads and writes and offers twice as much storage capacity as that of previous designs (pg 111).

**Dallas Semiconductor Corp.**  
Circle No 354



## GENERATOR

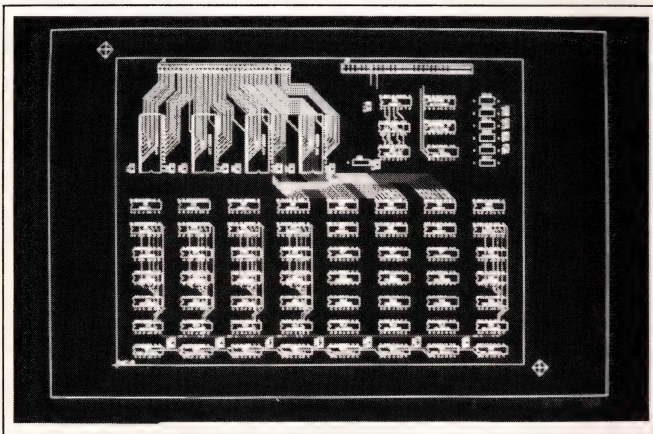
The DG535 digital delay generator provides four precisely timed logic transitions and two precisely controlled pulses whose edge delays can be set with 5-psec resolution (pg 118).

**Stanford Research Systems.**  
Circle No 352

## CABLE ADAPTER ▶

The D Subminiature Gender Changer is a cable adapter that minimizes the space required to adapt female-to-female connections (pg 232).

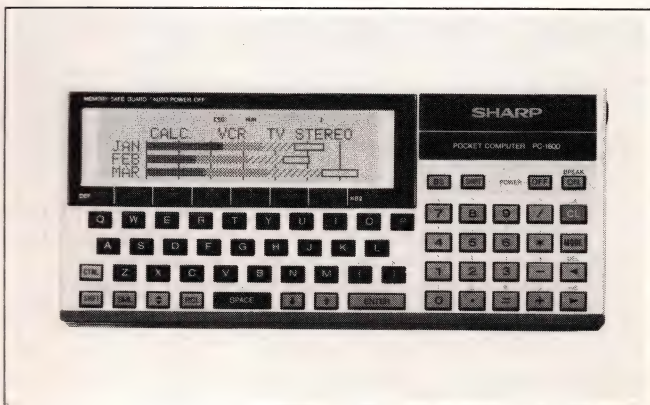
**ITT.**  
Circle No 353



## ▲ PC-BOARD LAYOUT

The Ed-Layout pc-board-layout package includes utilities that speed board definition and placement of parts; it runs on IBM PCs and compatible computers (pg 220).

**Control Data Corp.** Circle No 355



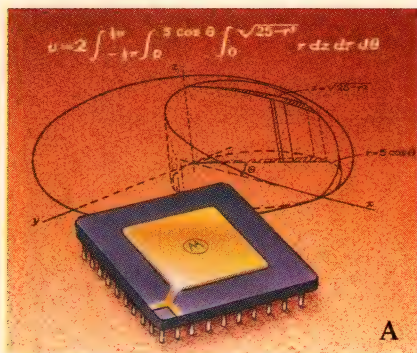
## ▲ HANDHELD COMPUTER

The PC-1600 computer weighs less than a pound and offers floppy-disk storage as an option (pg 231).

**Sharp Electronics Corp.**  
Circle No 356



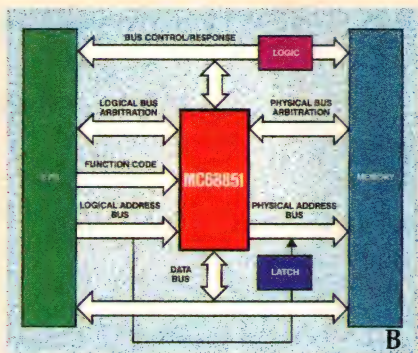
# Motorola M68000



## Floating point coprocessor has it all.

The MC68881 Floating Point Coprocessor serves M68000 Family and non-Motorola processors with a blend of complete conformance to the IEEE binary floating point standard (754), the four basic arithmetic functions, plus over 40 transcendental and non-transcendental functions including root values, trig functions, logs, exponentials and hyperbolics.

All functions are worked to 80 bits of precision in hardware, and it can break the million Whetstone performance mark.



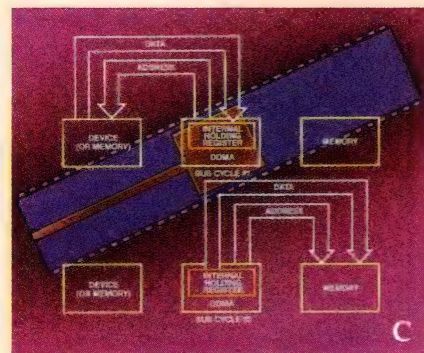
## Memory management support for virtual memory environments.

Memory management for M68000 Family processors is performed by the MC68851 Paged Memory Management Unit and MC68451 MMU.

The MC68851 supports a demand-paged virtual memory environment with the high-performance 32-bit MC68020 MPU.

On-chip address translation minimizes translation delays and maximizes system performance.

The MC68451 provides address translation, write protection and task access protection for MC68010-based systems.



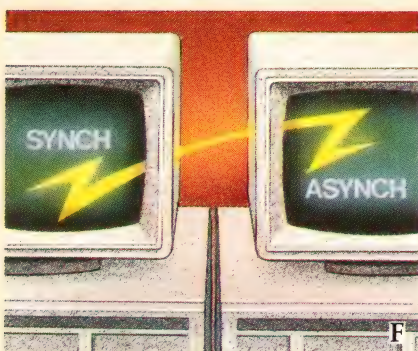
## DMA moves and manipulates data on multiple channels.

Three DMA Controllers of varied functionality serve the M68000 Family.

The MC68450 performs high-speed data movement and sophisticated data manipulation in complex systems. It's pin compatible with the MC68440 and '442.

The MC68440 moves blocks of data quickly and efficiently on two independent DMA channels. Channel switching and set up is also very fast.

The MC68442, with extra addressing for 32-bit MPUs, is an expanded version of the '68440.

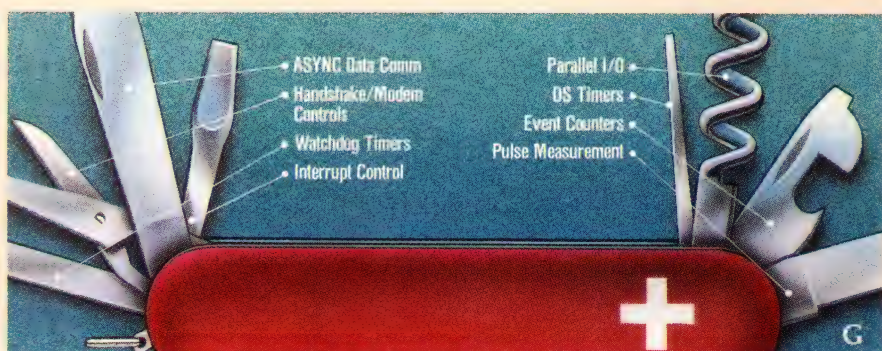


## Versatile answers for the need to communicate data.

The MC68661 is a universal synchronous/asynchronous communications controller for M68000 and most other 8- and 16-bit MPUs. Receiver and transmitter are double-buffered for efficient full- and half-duplex operation. No system clock is used.

It can simultaneously convert parallel data from the MPU data bus to transmit-serial data and receive-serial data to parallel characters for MPU input.

The MC68652 is a single-channel serial data device that recognizes byte-control and bit-oriented protocols. It can operate at 2 Mbit/sec.



## General Purpose I/O interface supreme, with DUART, Multifunction Peripheral and Interface/Timer circuits.

The MC68681 DUART has two independent full-duplex synchronous receiver/transmitter channels for direct M68000 MPU bus interface.

Receiver data registers are quadruple buffered, and transmitter data registers are double buffered to assure minimum MPU intervention. Power for complex data communications is from multifunction 6-bit input and 8-bit output ports, a 16-bit programmable counter/timer, interrupt handling ability and a one-megabyte/sec. maximum transfer rate.

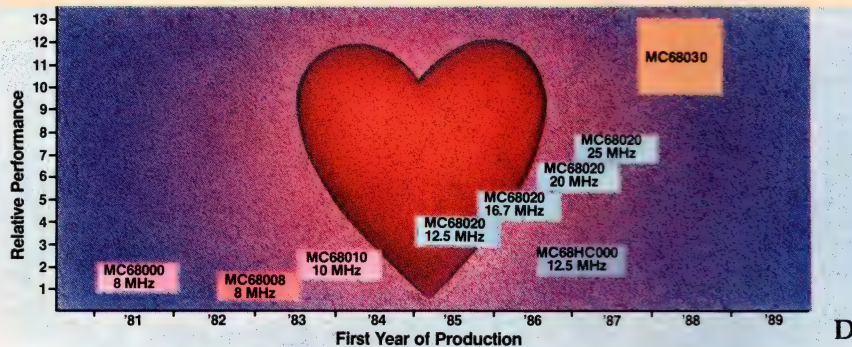
Our MC2681 is otherwise identical, but is without the M68000 bus interface.

The MC68901 multifunction circuit serves microcomputer requirements, via M68000 bus interface, with a single-channel UART for data communications. It has an 8-source interrupt controller, four 8-bit timers and eight parallel I/O lines.

The MC68230 is a programmable interface/timer with versatile double-buffered, unidirectional or bidirectional, parallel interfaces and an M68000 system timer. It also has the full M68000 bus interface.



# Family Today



## Highest-performance 8-, 16- and 32-bit MPUs and an easy migration path for your products.

At the heart of the M68000 Family are the industry's highest-performance software-compatible 8-, 16- and 32-bit MPUs, with operating speeds from 8 MHz for low-cost applications to the highest-speed general-purpose MPUs available at 25 MHz.

Products based on M68000 MPUs have become the standard for systems based on UNIX® operating systems, CAD/CAM engineering workstations, next-generation office automation equipment, color graphics systems, Multi-user/multi-tasking systems and real-time factory automation equipment. And, M68000 MPUs are also

the preferred engines for artificial intelligence, which requires high performance and large linear addressing capability.

M68000 Family microprocessors were designed with a large, flexible 32-bit register set, large linear address space, simple but powerful instruction set and flexible addressing modes.

The common 32-bit internal architecture of all the family MPUs provides high performance and software object code compatibility: an easy product migration path for your 8, 16- and 32-bit M68000-based products.



## X.25 Protocol Controller.

Motorola's MC68605 implements level 2 of the 1984 CCITT X.25 Recommendation Link Access Procedure Balanced LAPB.

It independently supports full-duplex point-to-point serial communications up to 10 Mbps generating link level commands and responses. In transparent operation (monitor mode), frames are user-generated with the MC68605 providing HDLC framing and CRC checking/generation.

## Send for information.

For direct discussion of designing-in the M68000 Family MPUs and peripherals, contact your Motorola sales office or authorized Motorola distributor. For M68000 Family technical literature, please complete and submit the coupon.

We're  
on your  
design-in  
team.



## Chips for MAP Communications.

Motorola's MC68824 is the only single-chip implementation of the IEEE 802.4 Media Access Control sublayer of the ISO Data Link Layer specified by MAP, the GM Manufacturing Automation Protocol.

It supports serial data rates of 1, 5 and 10 Mbps, and relieves the host processor of frame-formatting and token-management functions.

The MC68184 Broadband Interface Controller completely implements the digital functions necessary for an IEEE 802.4 broadband modem as specified in MAP.



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European Semiconductor Group

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Please send me the following information on the M68000 Family.

- |  |  |
|--|--|
| <input type="checkbox"/> A Floating Point Coprocessor  | <input type="checkbox"/> E X.25 Protocol Control                   |
| <input type="checkbox"/> B Memory Management   | <input type="checkbox"/> F Communications Peripherals              |
| <input type="checkbox"/> C DMA Control   | <input type="checkbox"/> G General Purpose I/O                     |
| <input type="checkbox"/> D Kit Brochure. Kits available from authorized Motorola distributors only. Contact yours. | <input type="checkbox"/> H Manufacturing Automation Protocol (MAP) |

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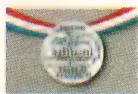
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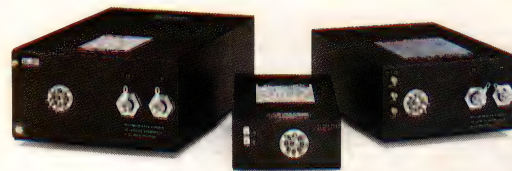
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MILITARY POWER SUPPLIES



# LEADTIME INDEX

Percentage of respondents

ITEM	Off the shelf	1-5 weeks	6-10 weeks	11-20 weeks	21-30 weeks	Over 30 weeks	Last month's average (weeks)	Average (weeks)
<b>TRANSFORMERS</b>								
Toroidal	12	29	24	35	0	0	8.1	8.5
Pot-Core	11	34	33	22	0	0	6.9	7.3
Laminate (power)	6	25	31	38	0	0	9.0	8.9
<b>CONNECTORS</b>								
Military panel	40	20	40	0	0	0	3.6	13.8
Flat/Cable	28	39	33	0	0	0	3.4	4.6
Multipin circular	12	50	35	0	0	0	4.5	7.4
PC	6	65	12	17	0	0	5.1	7.1
RF/Coaxial	40	50	10	0	0	0	1.8	5.4
Socket	28	33	28	11	0	0	4.7	5.3
Terminal blocks	17	50	28	5	0	0	4.1	6.3
Edge card	19	31	31	19	0	0	6.1	5.9
Subminiature	18	39	36	9	0	0	5.1	7.3
Rack & panel	14	29	28	29	0	0	7.4	9.8
Power	0	50	50	0	0	0	5.0	8.2
<b>PRINTED CIRCUIT BOARDS</b>								
Single-sided	0	52	48	0	0	0	4.9	5.1
Double-sided	0	48	52	0	0	0	5.1	5.0
Multilayer	0	15	85	0	0	0	7.1	9.0
Prototype	4	91	5	0	0	0	2.2	3.0
<b>RESISTORS</b>								
Carbon film	44	37	19	0	0	0	2.2	3.6
Carbon composition	24	48	17	7	0	0	4.0	4.3
Metal film	36	27	32	5	0	0	3.8	3.8
Metal oxide	17	33	42	8	0	0	5.3	4.9
Wirewound	11	21	53	10	5	0	7.7	5.1
Potentiometers	9	37	17	35	0	0	7.7	5.5
Networks	30	40	20	0	5	5	5.2	6.0
<b>FUSES</b>								
	40	35	25	0	0	0	2.7	2.1
<b>SWITCHES</b>								
Pushbutton	6	50	33	11	0	0	5.4	6.4
Rotary	0	47	41	12	0	0	6.1	8.2
Rocker	18	41	35	6	0	0	4.6	5.8
Thumbwheel	0	45	33	11	11	0	8.2	6.8
Snap action	9	46	27	9	9	0	6.9	5.3
Momentary	0	57	29	14	0	0	5.7	6.4
Dual in-line	0	57	29	14	0	0	5.7	6.2
<b>WIRE AND CABLE</b>								
Coaxial	44	44	12	0	0	0	1.9	3.2
Flat ribbon	53	21	26	0	0	0	2.5	4.5
Multiconductor	60	27	13	0	0	0	1.6	5.3
Hookup	50	42	8	0	0	0	1.5	3.7
Wire wrap	36	50	14	0	0	0	2.1	3.4
Power cords	36	32	28	4	0	0	3.5	5.4
Other	33	0	67	0	0	0	5.3	6.0
<b>POWER SUPPLIES</b>								
Switching	0	46	54	0	0	0	5.2	9.3
Linear	7	43	50	0	0	0	4.8	7.3
<b>CIRCUIT BREAKERS</b>								
	14	29	50	7	0	0	5.7	6.8
<b>HEAT SINKS</b>								
	23	45	32	0	0	0	3.5	4.5

ITEM	Off the shelf	1-5 weeks	6-10 weeks	11-20 weeks	21-30 weeks	Over 30 weeks	Last month's average (weeks)	Average (weeks)
<b>RELAYS</b>								
General purpose	27	33	20	20	0	0	5.5	6.3
PC board	8	46	15	31	0	0	7.1	8.5
Dry reed	0	33	34	33	0	0	8.7	9.2
Mercury	0	60	20	20	0	0	6.0	8.4
Solid state	27	36	9	10	18	0	7.6	10.0
<b>DISCRETE SEMICONDUCTORS</b>								
Diode	32	44	16	8	0	0	3.4	4.8
Zener	28	28	33	11	0	0	5.0	5.9
Thyristor	38	25	25	12	0	0	4.5	8.0
Small signal transistor	20	40	27	13	0	0	5.1	7.0
FET, MOS	9	27	46	18	0	0	7.1	8.9
Power, bipolar	22	22	33	22	0	0	6.7	7.6
<b>INTEGRATED CIRCUITS, DIGITAL</b>								
CMOS	10	58	21	11	0	0	4.5	7.8
TTL	13	50	31	6	0	0	4.5	6.5
LS	21	47	21	11	0	0	4.3	6.7
<b>INTEGRATED CIRCUITS, LINEAR</b>								
Communication/circuit	25	50	12	13	0	0	4.0	8.9
OP amplifier	4	45	27	14	5	0	6.5	6.9
Voltage regulator	19	50	19	12	0	0	4.5	5.4
<b>MEMORY CIRCUITS</b>								
RAM 16k	30	30	30	10	0	0	4.6	6.1
RAM 64k	42	25	17	16	0	0	4.5	5.3
RAM 256k	10	50	20	20	0	0	5.8	6.0
ROM/PROM	25	25	17	33	0	0	7.2	7.7
EPROM	27	33	20	20	0	0	5.5	5.4
EEPROM	11	33	22	34	0	0	7.8	6.4
<b>DISPLAYS</b>								
Panel meters	18	27	27	28	0	0	7.1	7.7
Fluorescent	0	25	50	25	0	0	8.5	10.0
Incandescent	0	20	50	20	0	0	8.4	10.3
LED	14	38	43	5	0	0	4.9	5.6
Liquid crystal	12	37	13	38	0	0	7.8	8.5
<b>MICROPROCESSOR ICs</b>								
8-bit	18	27	27	28	0	0	7.1	7.6
16-bit	13	62	13	12	0	0	4.3	9.1
<b>FUNCTION PACKAGES</b>								
Amplifier	17	33	33	17	0	0	6.0	9.5
Converter, analog to digital	0	30	20	50	0	0	10.2	8.5
Converter, digital to analog	0	12	38	50	0	0	11.3	9.2
<b>LINE FILTERS</b>								
	9	46	36	9	0	0	5.3	8.5
<b>CAPACITORS</b>								
Ceramic	31	31	21	17	0	0	5.0	6.3
Ceramic monolithic	31	21	32	16	0	0	5.5	5.9
Ceramic disc	30	35	25	10	0	0	4.3	6.5
Film	27	36	28	9	0	0	4.4	6.7
Electrolytic	17	29	37	17	0	0	6.3	5.8
Tantalum	17	27	37	17	0	0	6.3	7.2
<b>INDUCTORS</b>								
	14	38	43	15	0	0	6.3	6.8

Source: Electronics Purchasing magazine's survey of buyers



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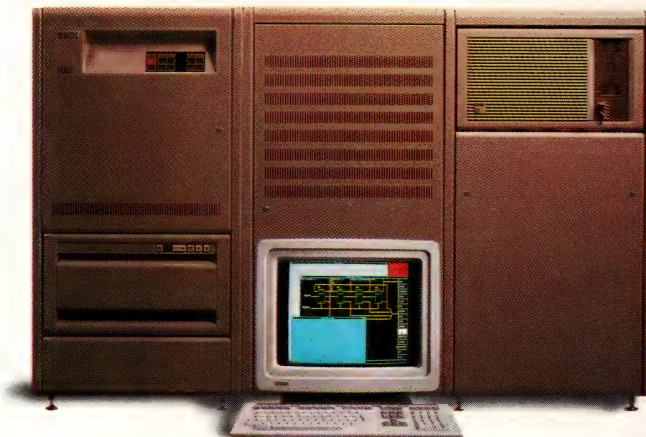
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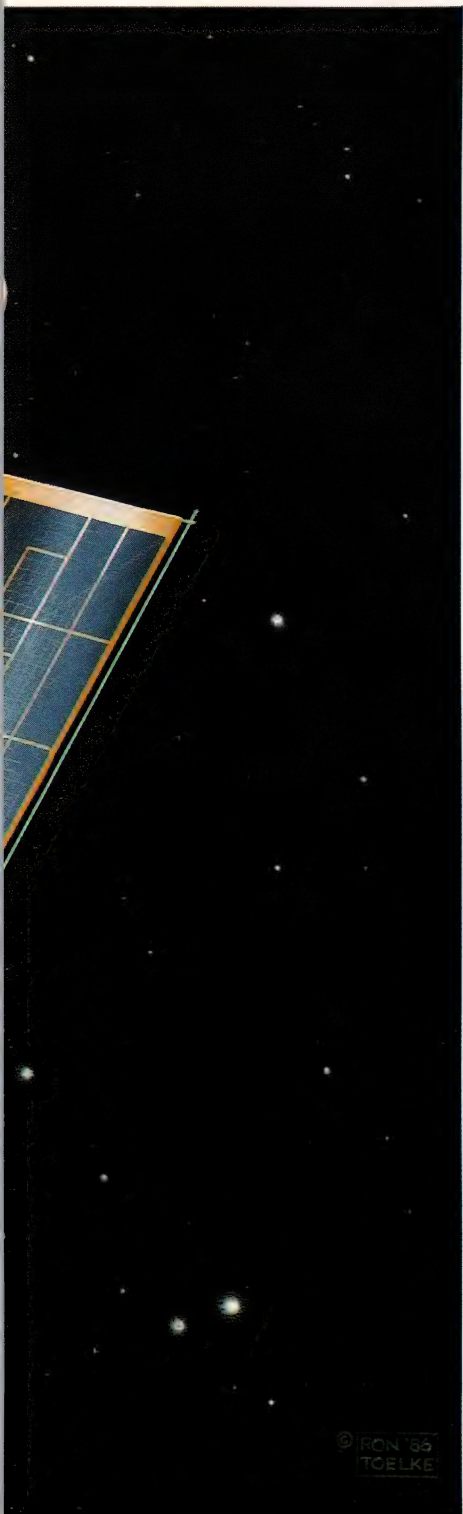


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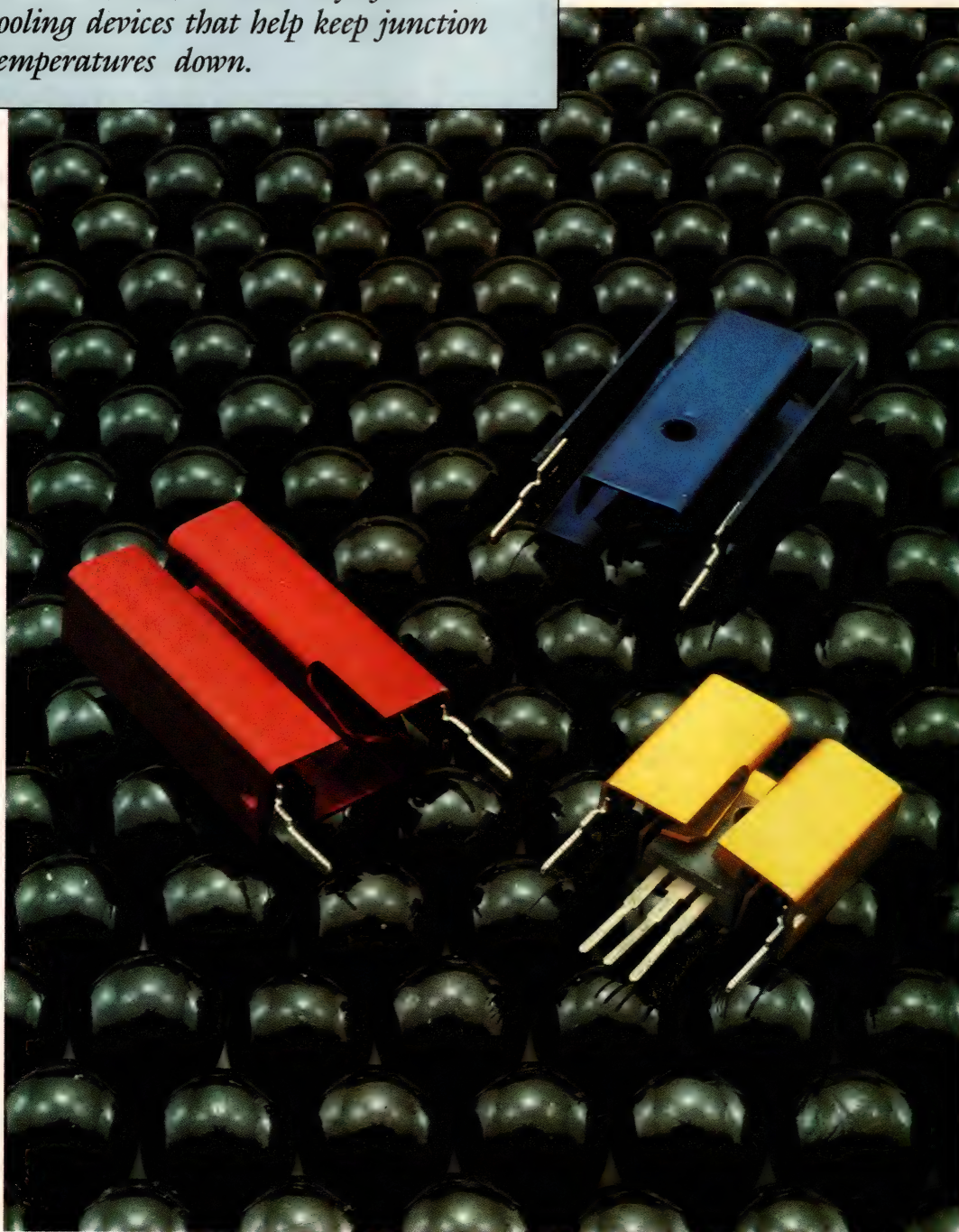


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*Besides the usual fans and blowers used to carry heat away from semiconductors, you have access to a variety of local cooling devices that help keep junction temperatures down.*



*Heat sinks for plastic power semiconductors (Aavid Engineering Inc)*



# Heat-removal devices hold semiconductors within operating ranges

Bill Travis, *Senior Editor*

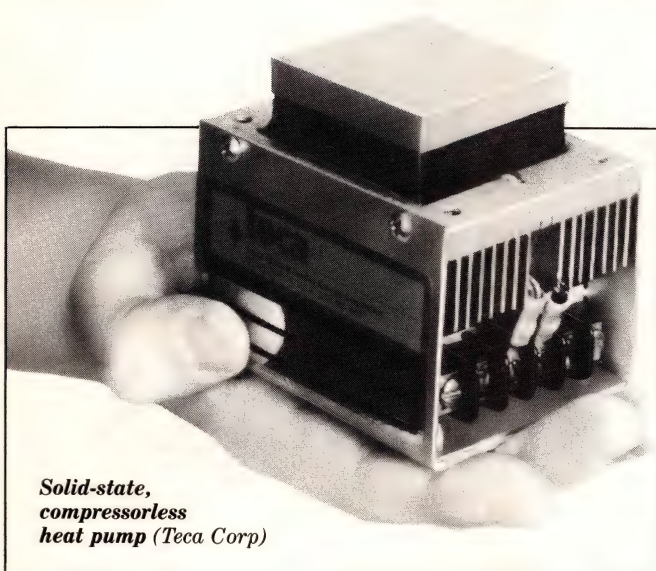
**I**n any electronic system you design, you should give careful consideration to cooling the system's semiconductors, for two reasons. First, reliability: A semiconductor's failure rate increases exponentially as the junction temperature rises. Second, all semiconductors' specs use 25°C as a baseline, and any deviation therefrom entails spec compromises in terms of accuracy, leakage currents, and other parameters. Some examples of the two dominant types of local cooling devices—heat sinks and thermoelectric coolers—show you how to keep semiconductor junctions and assemblies cool.

Heat sinks are designed to reduce the case-to-ambient thermal resistance ( $\theta_{CA}$ ) of ICs and discrete semiconductors. They're important components, because the junction-to-case thermal resistance ( $\theta_{JC}$ ) and  $\theta_{CA}$  are in series, so it's most often the latter thermal resistance that determines a junction's temperature rise. Heat sinks have been around since time immemorial; no revolutionary developments have occurred in the devices. However, some recent heat sinks offer features that are worth your attention.

The past few years have seen an enormous growth in the use of plastic-packaged power devices—for example, bipolar transistors, power MOSFETs, and SCRs. The two most popular power packages are the TO-220 and the heftier TO-218, and it's only natural that heat-sink manufacturers would develop heat sinks that accommodate these packages. One such company, Aavid Engineering Inc, has recently released a spate of TO-220 and TO-218 heat sinks.

One of Aavid's specialties is labor-saving heat sinks that make contact with the semiconductor by means of spring action. Two recent devices are designed for TO-220 semiconductors. Model 5933 is a plug-in design with special stepped tabs that provide a tight fit between the heat sink and the pc board. Made of anodized aluminum, the 5933 comes in three heights: 0.69, 0.75, and 1.375 in. The 0.75-in. unit costs \$0.185 (1000). Another plug-in device, the industry's smallest according to the manufacturer, is Model 5910. The 0.5-in.-wide unit has four spring clips that hold each corner of the semiconductor. A tinned brass tab allows





**Solid-state,  
compressorless  
heat pump** (Teca Corp)

you to solder the heat sink directly to a pc board. Model 5910 costs \$0.225 (1000).

Another category of heat sinks accepts both TO-220 and TO-218 semiconductors. The 12-fin, extruded Series 5334-36 from Aavid uses insertable spring clips to hold the semiconductor firmly in the heat sink. It provides cooling for devices dissipating as much as 20W (under natural convection). Available in heights of 1, 1.5, 2, and 2.5 in., the devices provide two solderable pins for vertical mounting. For the 2-in. unit, the price is \$0.795 (1000).

Another source of easy-to-use heat sinks is EG&G Wakefield Engineering. Model 285, for example, accommodates both TO-220 and TO-218 packages. Two hexagonal, solderable lugs allow you to wave-solder the heat sink to pc boards. A spring clip holds the semiconductor to the heat sink. The device measures 2 in. high by 1.38 in. wide by 0.5 in. thick. It costs \$0.34 (1000).

Extrusion is a traditional method for making heat sinks. Stamping, however, is a much less costly production technique. A recent heat sink from Aavid combines the cost savings of stamped heat sinks with the thermal performance of more expensive extruded parts. Model 5931, according to the manufacturer, is comparable in performance to the company's earlier 6130 extruded device.

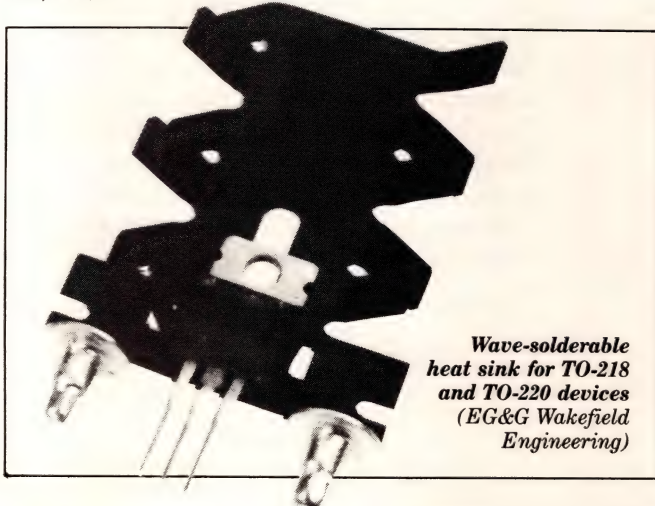
Accommodating both TO-220 and TO-218 devices, the 5931 heat sink provides solderable tabs for vertical mounting. You can mount semiconductors on both sides of the heat sink. The unit's design provides for free air circulation on all sides. Under natural convection, the device handles power dissipation as high as 10W. Made of aluminum alloy, the \$0.219 (1000) 5931 is available in gold chromate and a black, red, blue, or bronze anodized finish.

Members of another family of stamped heat sinks from Aavid, the Series 5197-5201, accept TO-3, -66, -220, and -218 packages. The 1.9-in.-long, 1.55-in.-wide heat sinks are available in four heights ranging from 1.225 to 2 in. You can use the same screw to mount the semiconductor and heat sink to the pc board. Under natural convection, the smallest heat sink holds the temperature rise to 50°C for 10W dissipation. A typical version costs \$0.637 (1000).

One low-cost Aavid heat sink designed for TO-3 devices allows you to mount both the semiconductor and the heat sink with the same fastener. The 5251-54 Series has a universal hole pattern that accepts 2-, 3-, and 4-lead TO-3 packages. The heat sinks come in four heights from 0.5 to 1.25 in. Under natural convection, the 1-in. unit will hold the temperature rise to 35°C for 5W dissipation. For the 1-in. unit, the price is \$0.39 (1000).

In applications that use LSI circuits, it's important to consider carefully the problem of getting the heat out of these sometimes power-hungry ICs. You'll have provided a fan, of course, to cool the system board. But even in the presence of moving air, the IC's  $\theta_{CA}$  can impede the flow of heat from the semiconductor junction to the cooler outside world. A couple of heat sinks from EG&G Wakefield Engineering help keep your LSI circuits cool.

Model 830 is a heat sink that you bond to the lid of an LSI device, using a thermally conductive adhesive. You can attach the heat sink directly to a Textool 68-pin chip-carrier socket. The heat sink has an array of cylindrical pins that are perpendicular to its top surface. The pins (dubbed "pin fins" by the manufacturer) provide omnidirectional cooling. Model 830 costs \$0.80 (25,000).



**Wave-solderable  
heat sink for TO-218  
and TO-220 devices**  
(EG&G Wakefield  
Engineering)

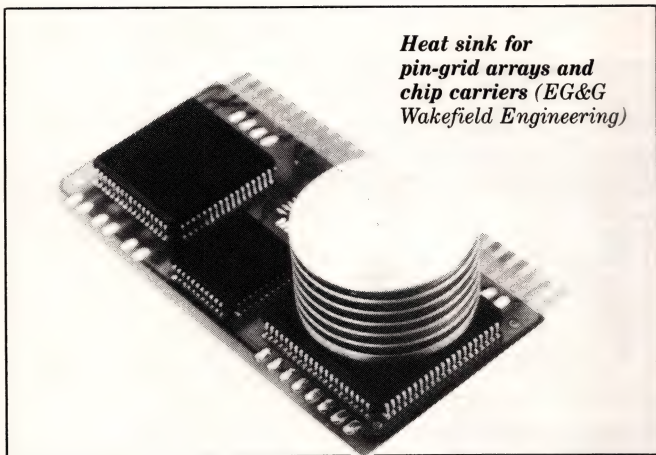


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*The two most popular power packages are the TO-220 and the TO-218, and it's only natural that heat-sink manufacturers would develop heat sinks for these packages.*

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*Heat sink for  
pin-grid arrays and  
chip carriers (EG&G  
Wakefield Engineering)*



Another LSI-circuit heat sink from EG&G Wakefield Engineering, the 850 Series, accommodates chip-carrier and pin-grid-array ICs that dissipate power as high as 10W (under forced convection). The heat sinks use a radial design that resembles a stack of metal disks; this circular design can use airflow from any direction. You use a thermally conductive adhesive to bond the 850 to the lid of an IC. Measuring 1.25 in. in diameter, the 850 is available in two heights—0.7 and 0.39 in.—at prices of \$0.87 and \$0.83 (1000), respectively.

In some applications, special considerations preclude the classic heat-sink/blower method for cooling your circuitry. These considerations can take the form of size and weight constraints, the need for extremely high reliability, or such environmental aspects as the need to operate in a vacuum. In these cases, you can obtain cooling devices that are, in essence, thermocouples applied backwards. These devices are thermoelectric modules—heat pumps that use the Peltier effect for cooling.

To understand the operation of thermoelectric modules, imagine a thermocouple composed of two dissimilar metals. The two metals are connected to form two junctions. You hold one of the junctions at a reference temperature and apply the other to the object whose temperature you want to measure. If you open the circuit, you'll see that the temperature differential causes the generation of a voltage. Now, imagine applying the thermocouple backwards: You apply electrical energy into a pair of fixed junctions. One junction becomes cold and the other becomes hot. This temperature-generating phenomenon is called the Peltier effect, as opposed to the thermocouple's mirror-image Seebeck effect.

Fig 1a shows a cross section of a typical thermoelec-

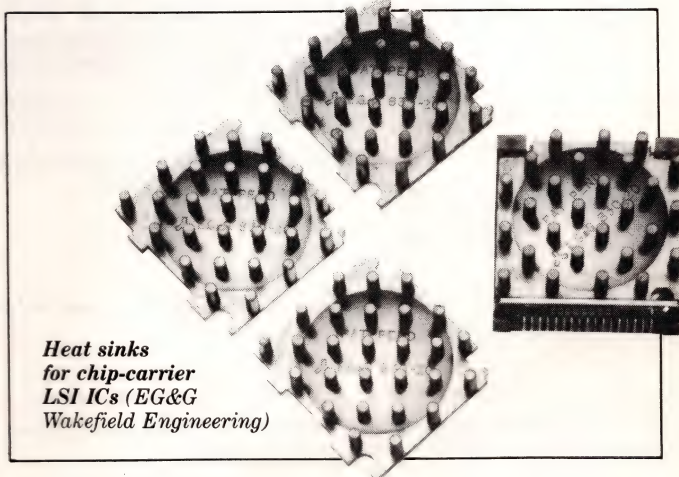
tric module. The module uses two semiconductor elements, typically bismuth-telluride, heavily doped to create either an excess (n type) or deficiency (p type) of electrons. The cooling module pumps the heat absorbed at the cold junction to the hot junction at a rate proportional to the carrier current and the number of couples. Practical thermoelectric modules (Fig 1b) usually use a number of couples in a cascade arrangement (that is, in series electrically and in parallel thermally).

If you choose to use a thermoelectric module for cooling, you must determine three application-specific parameters: the cold-surface temperature that you must maintain, the hot-surface temperature that your system can tolerate, and the amount of heat to be removed by the cooling module's cold surface. You can then consult the module manufacturer's specs and curves to make your selection of an appropriate cooling module.

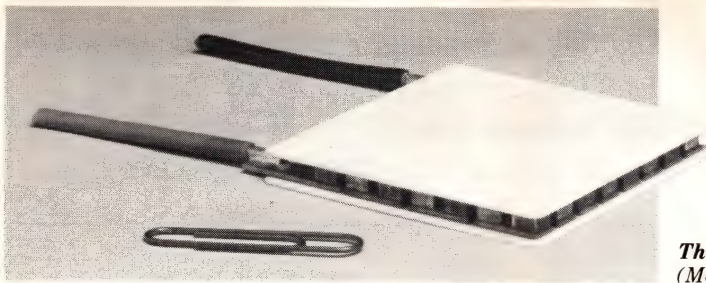
A leading manufacturer of thermoelectric cooling modules is Melcor Thermoelectrics. The company offers a line of 61 standard modules of different ratings and dimensions. In addition to its standard modules, Melcor makes custom units for particular applications. Series FC comprises 23 miniature modules weighing less than 0.7g. Cold-surface dimensions range from 1.8×3.4 to 12.3×11.3 mm.

To gain a feel for the capabilities of these miniature modules, consider some specs for the smallest and largest units in the FC Series. Model FC 0.45-4-05L takes 0.8A max cooling current and can generate a 67°C temperature differential between the cold and hot surfaces for devices that dissipate power as high as 0.22W. The differential spec simply tells you that, to keep a semiconductor's temperature at 25°C, you have to ensure that the temperature of the hot surface

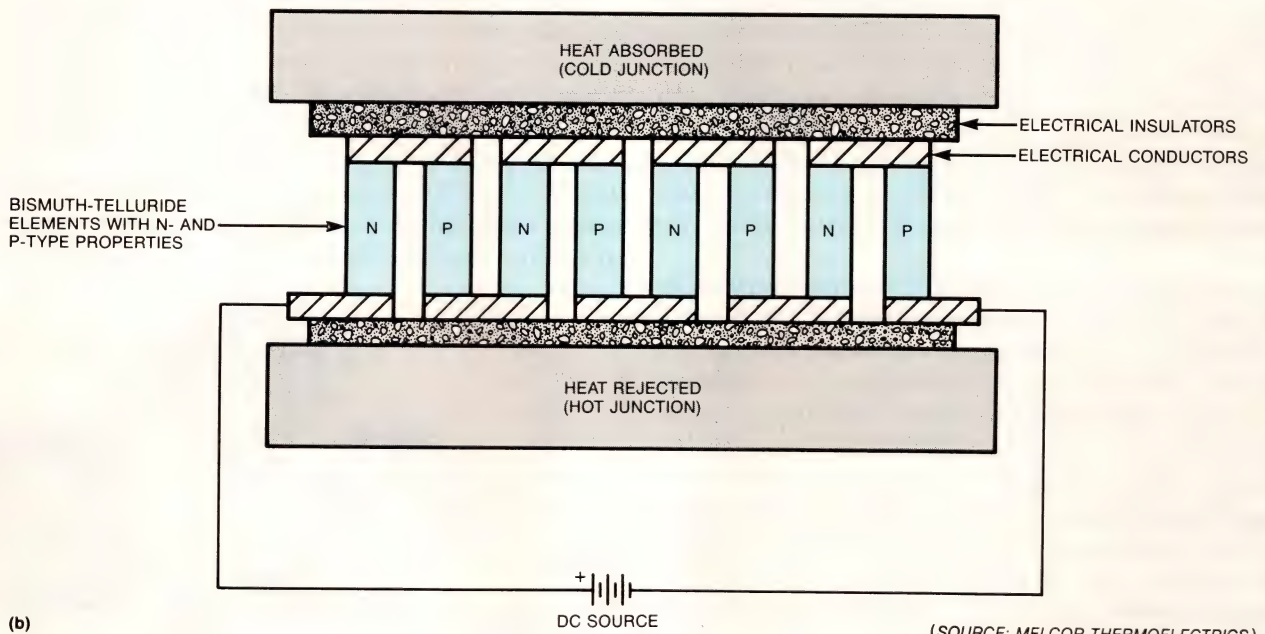
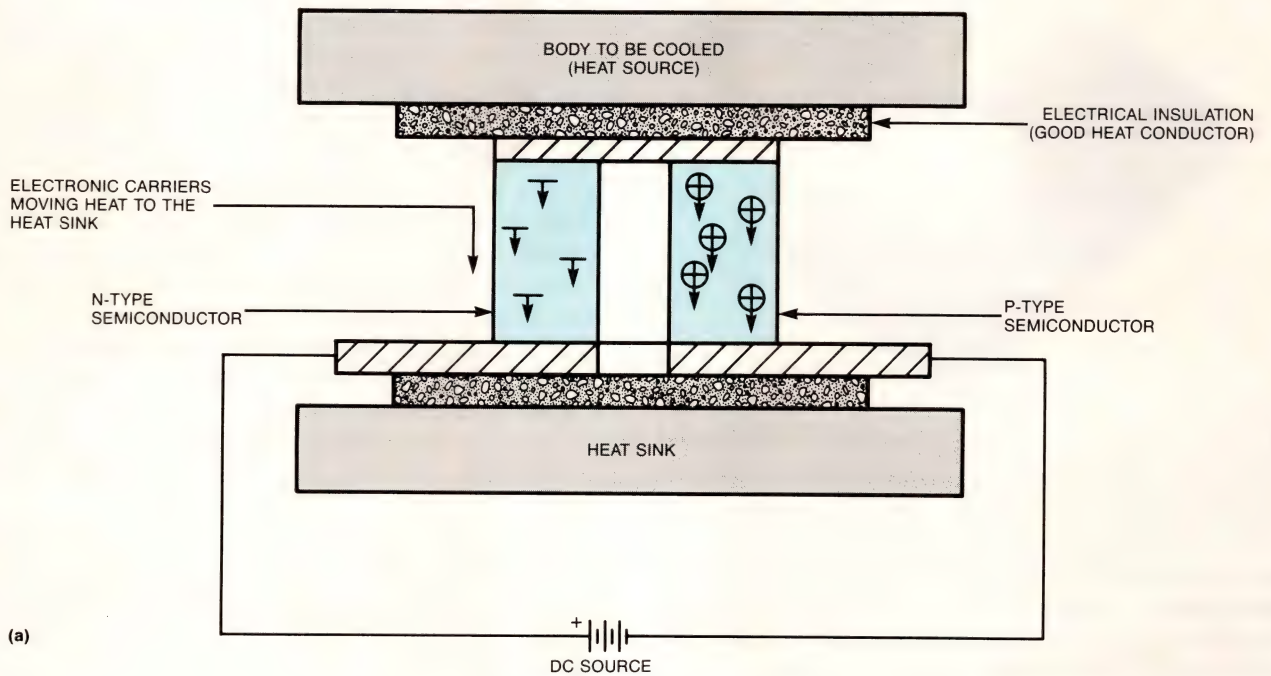
*Heat sinks  
for chip-carrier  
LSI ICs (EG&G  
Wakefield Engineering)*







**Thermoelectric cooling module**  
(Melcor Thermoelectrics)



(SOURCE: MELCOR THERMOELECTRICS)

**Fig 1—A typical thermoelectric module (a) uses differently doped semiconductor elements to produce the Peltier effect. By cascading elements (b), you multiply the module's cooling capacity.**



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*Extrusion is a traditional method for making heat sinks. Stamping, however, is a much less costly production technique.*

---

doesn't exceed 92°C. The module's operating-temperature range is -150 to +110°C. The "4" in the part number designates the number of couples the device uses. The largest of the FC Series, Model FC 0.6-66-05L, uses 66 couples and accepts cooling currents as high as 1.5A. It can cool a 6.67W device while providing a 67°C differential.

### **Larger part for more cooling capability**

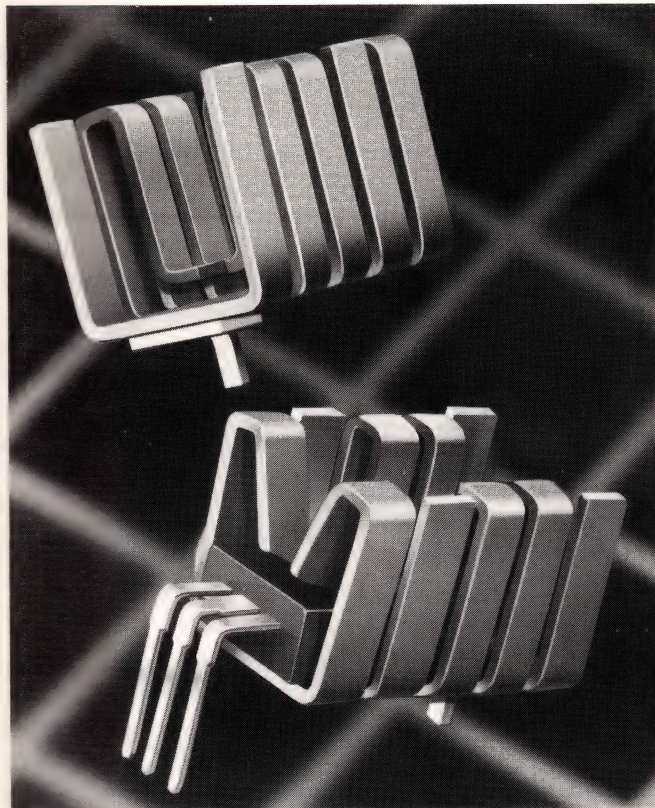
If your cooling requirements exceed the capabilities of the FC Series, consider Melcor's not-so-miniature CP Series. These devices range in cold-surface dimensions from 7.5×7.5 to 55×55 mm and weigh 1.5 to 73g. The smallest module in the CP Series is the 7-couple CP 1.0-7-06L. This device uses a 3A max cooling current, and it can provide a 67°C differential to a load that dissipates 1.4W. The behemoth of the Series is the 31-couple CP 5-31-06L, a module that takes a 60A max cooling current and handles 125W for the 67°C cold-hot differential.

Note that thermoelectric modules don't give you something for nothing. The CP 5-31-06L, for example, draws 225W from its supply under maximum cooling conditions. Its coefficient of performance (COP) is  $125W \div 225W$ , or 0.56. In applying the device in a system, you must make sure the hot surface can get rid of the 125W plus the 225W.

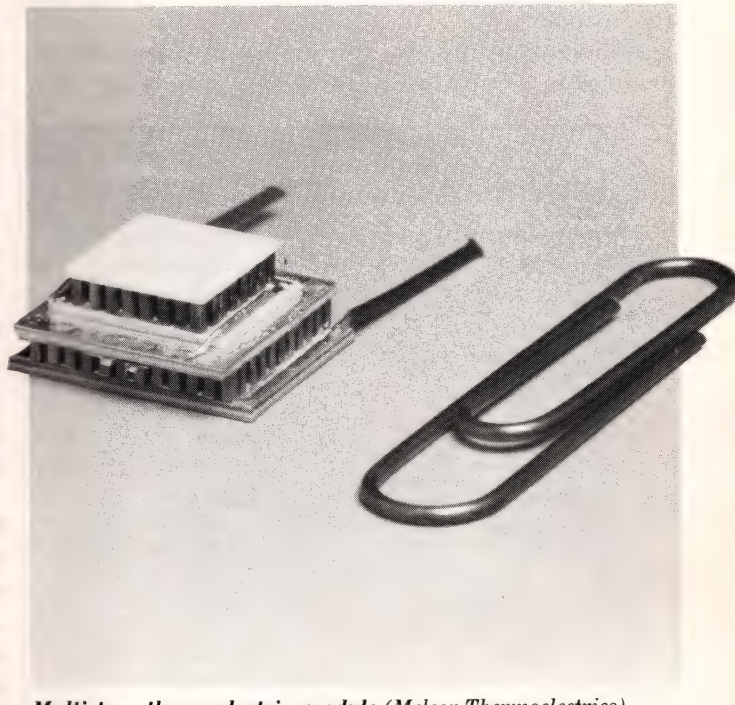
Melcor supplies its modules in three variations: with both hot and cold (ceramic) surfaces lapped flat; with both faces metallized and tinned; and with the hot face tinned and the cold face lapped. Prices for the FC Series range from \$6 to \$31.10; for the CP Series, from \$4.65 to \$28.50 (1000).

Inasmuch as you can obtain thermoelectric modules of miniscule dimensions, a natural application that springs to mind is to make the module an integral part of a semiconductor device. The modules are particularly appropriate for such devices as laser diodes and fiber-optic ICs. Midland-Ross Cambion Div promotes its Mini-Module thermoelectric coolers for these applications, and the company works closely, on a custom basis, with device manufacturers in integrating the coolers.

**Fig 2** shows a Mini-Module integrated into a JEDEC TO-5 optical-window package. In this application, the semiconductor chip is bonded to the cold surface of the cooling module; the hot surface attaches to the TO-5 base, which acts as a heat sink. According to the company, the thermoelectric module can maintain the semiconductor's temperature constant to within



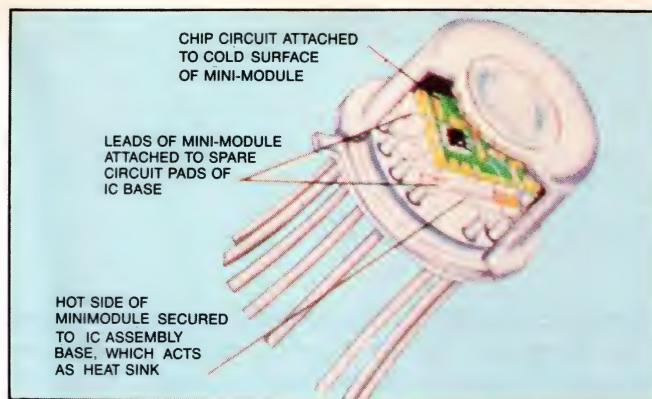
*Spring-clip heat sink for TO-220 devices (Aavid Engineering Inc)*



*Multistage thermoelectric module (Melcor Thermoelectrics)*



*In some applications, special considerations preclude the classic heat-sink/blower method for cooling devices down.*



**Fig 2—For the most localized cooling possible, you can integrate** Midland-Ross's Mini-Module thermoelectric modules directly into a semiconductor device's package. The TO-5 base serves as the heat sink that takes heat away from the thermoelectric device's hot surface.

$\pm 0.1^{\circ}\text{C}$ . The main reason for the popularity of thermoelectric modules in laser and fiber-optic applications is the prolonged lifetime of the cooled optical-emitter semiconductors.

In addition to its line of leadless Mini-Modules destined for integration, Midland-Ross offers a wide range of leaded modules. The devices come in various configurations—for example, rectangular ceramic, annular O ring, square with copper pads, square ceramic, and multistage (having two modules cascaded vertically). The rectangular units come in two series, rated for  $150^{\circ}\text{C}$  and  $250^{\circ}\text{C}$ . For a  $70^{\circ}\text{C}$  hot-cold differential, they handle loads dissipating 1.8 to 75W. O-ring devices operate at  $100^{\circ}\text{C}$  max and can cool 12W devices for a  $60^{\circ}\text{C}$  differential. The square devices operate at  $150^{\circ}\text{C}$  and cool loads dissipating 3.5 to 75W for a  $70^{\circ}\text{C}$  differential. The devices range in price from \$20 to \$150 (20 to 30 qty).

#### From micro to macro cooling

In addition to their utility as microelectronic cooling devices, thermoelectric modules find wide use as elements in large cooling assemblies. These assemblies consist of a finned heat sink and a cold plate; between the heat sink and cold plate are sandwiched two or more thermoelectric modules. The assemblies rely on forced-convection cooling (a fan) to carry the heat away from the heat sink.

Midland-Ross incorporates its line of thermoelectric modules in a range of large cooling assemblies. Five

models provide cooling (that is, hold the cold-surface temperature to  $25^{\circ}\text{C}$ ) for loads ranging from 25 to 250W. Model 803-1010-01-00-00, for example, uses 56W max input power to provide 25W of cooling; its cold-surface temperature under no-load conditions is  $-17^{\circ}\text{C}$ . The largest assembly, Model 803-1012-01-00-00, takes 360W max input power to cool a 250W load; its no-load cold-surface temperature is  $-15^{\circ}\text{C}$ . Assemblies in the 803 Series cost \$400 to \$800 (20 to 30 qty).

Another company, Teca (Thermoelectric Cooling America Corp), exploits its family of thermoelectric modules in the company's series of solid-state air conditioners and heat pumps. (The term "air conditioner" is a misnomer; these heat pumps do not exchange air between the outside and inside of the enclosure to be cooled.) The company rates its heat pumps in terms of BTU/hour (1 BTU/hour=3.41W). Models LHP-150, -300, -800, and -1700 provide cooling rates of 135, 305, 740, and 1500 BTU/hour, respectively. The LHP models all use liquid coolant to remove the heat; the -300, -800, and -1700 come in two versions using either a fan or a cold-side plate. LHP Series prices are \$295, \$435, \$925, and \$1375, respectively.

Teca offers five heat pumps that do not use liquid cooling. Instead, they use fans to remove heat. Models AHP-150, -300, -800, -1000, and -1700 provide cooling rates of 110, 240, 500, 560, and 1100 BTU/hour, respectively. Their prices are \$225, \$350, \$725, \$925, and \$995, respectively. In addition to cooling assemblies that incorporate thermoelectric modules, Teca sells its thermoelectric modules separately. For a  $66^{\circ}\text{C}$  hot-cold differential, the modules provide cooling power ranging from 1.8 to 30W. Unit prices for the thermoelectric modules range from \$15.50 to \$50.

**EDN**

### For more information . . .

For more information on the cooling devices described in this article, contact the following manufacturers directly or circle the appropriate numbers on the Information Retrieval Service card.

**Aavid Engineering Inc**  
Box 400  
Laconia, NH 03247  
(603) 524-4443  
Circle No 673

**EG&G Wakefield Engineering**  
60 Audubon Rd  
Wakefield, MA 01880  
(617) 245-5900  
Circle No 674

**Melcor Thermoelectrics**  
990 Spruce St  
Trenton, NJ 08648  
(609) 393-4178  
Circle No 675

**Midland-Ross Cambion Div**  
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Cambridge, MA 02140  
(617) 491-5400  
Circle No 676

**Teca Corp**  
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Chicago, IL 60622  
(312) 666-1600  
Circle No 677

Article Interest Quotient (Circle One)  
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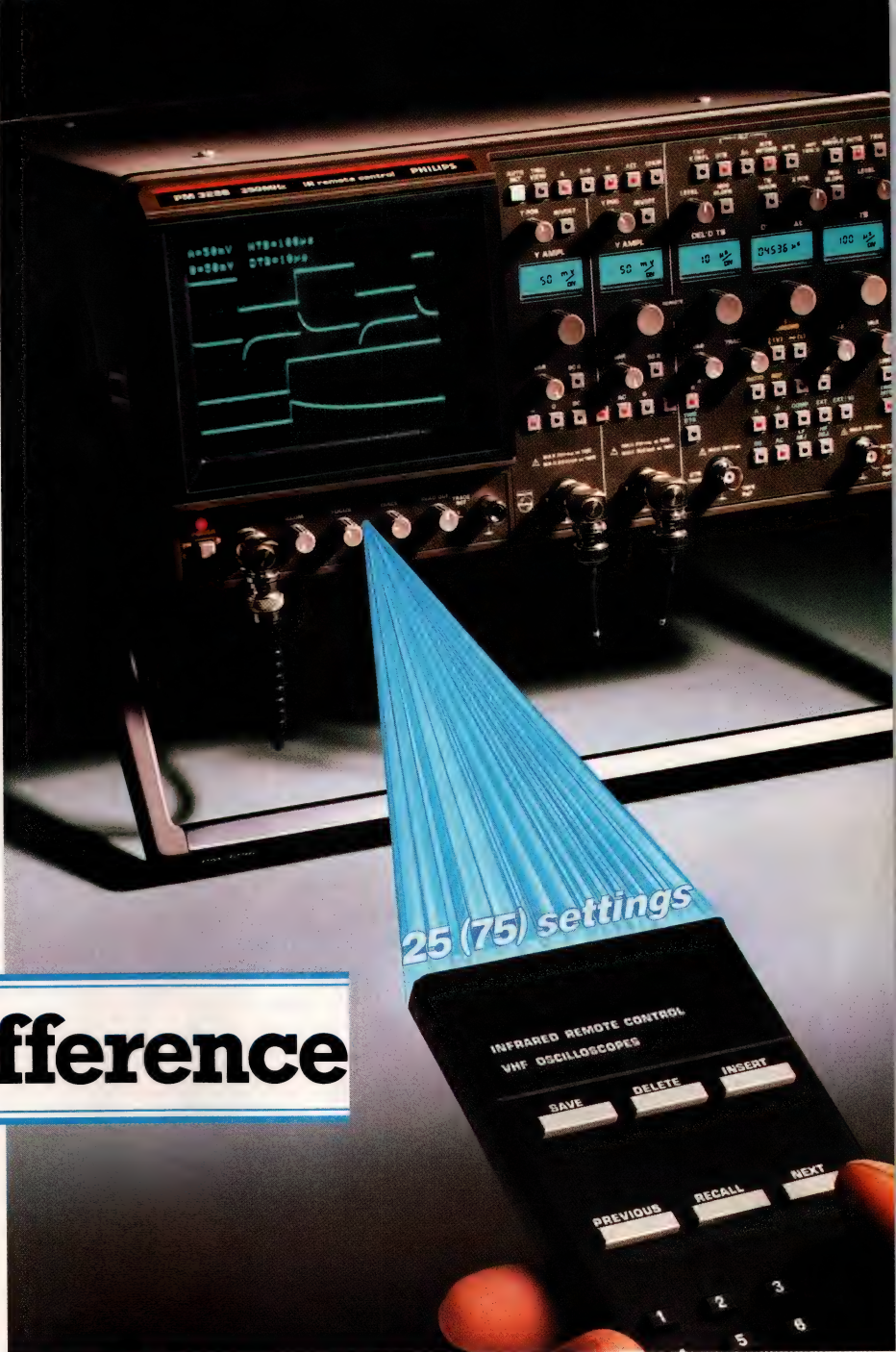
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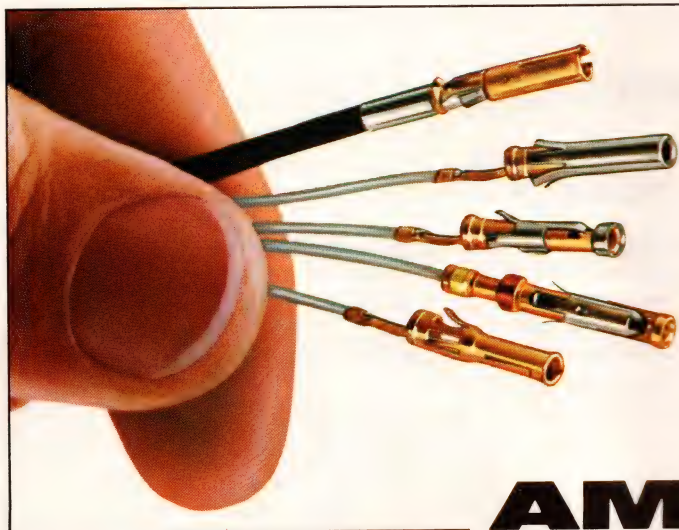
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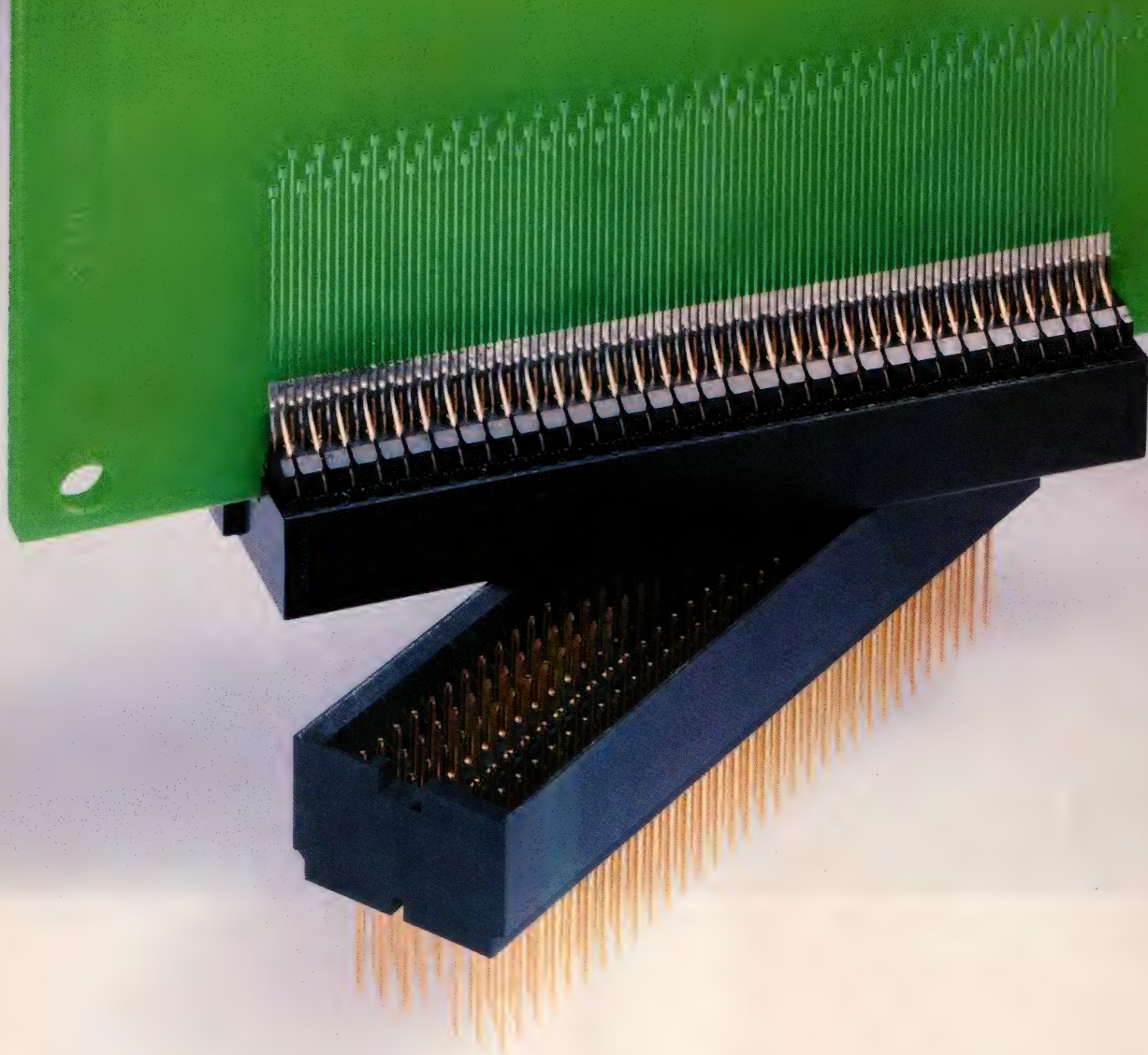
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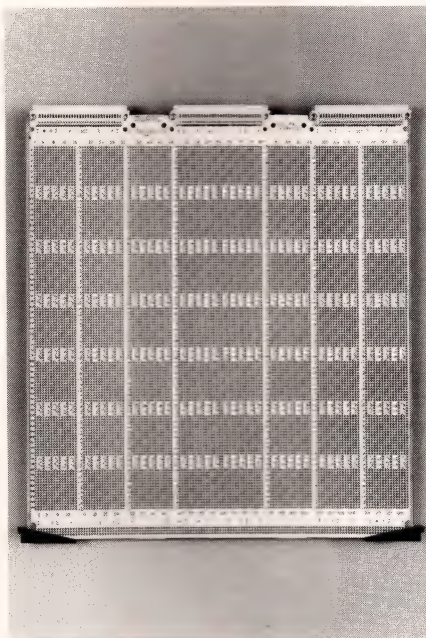


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The enclosures' strength and rigidity comes from the design of their corners. A heavy-gauge mounting plate is welded into the top of each corner post. This plate is recessed into the column; when the

assembler tightens the corner bolt, the plate and the contact area of the cabinet frame deflect, forming a broad contact surface. The corner joint's tab-and-slot construction also guarantees correct assembly. The corner posts are always in the proper position for side-panel and door mounting.

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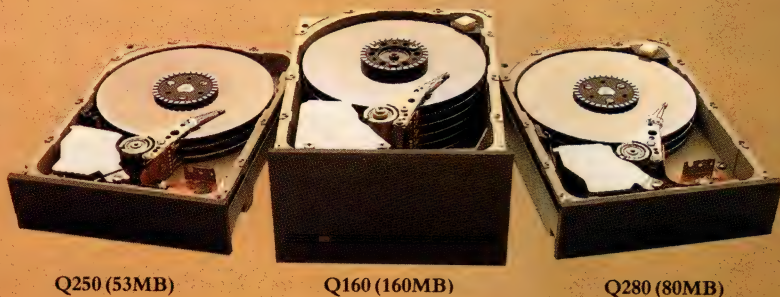
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Q250 (53MB)

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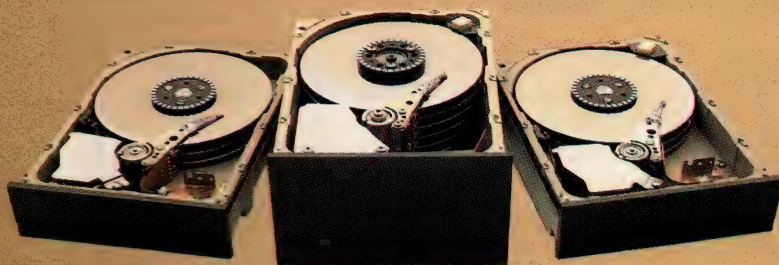
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20, 21 slots

J1 in optional mount cage  
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### Nine 19" Rack Mountable Card Cages

\* 21-slot 400mm x 6U, 9U  
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3, 4, 5, 6 slots

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J1, 220mm  
J2, 160mm  
J2, 220mm  
J1/J2 contiguous, 160mm  
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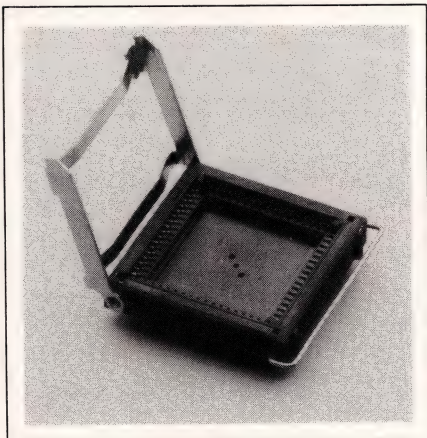
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# Hybricon

Corporation 410 Great Road, Littleton, Massachusetts (617) 486-0311 TWX 710-347-0654



# Hardware and Interconnect Devices



## LCC SOCKETS

Series 9074 sockets accept JEDEC Type A leadless chip carriers with 0.05-in. centers. The sockets have a 0.25-in. (installed) profile, so they permit board-to-board spacings on 0.5-in. centers.

Each socket is a 68-pin device consisting of a thermoplastic body; gold-plated beryllium copper contacts; a hinged, spring-action steel cover; a stainless-steel wire latch; and a steel biasing clip for internal registration. The cover is an integral part of the socket and requires no special tooling to open or close. The cover accommodates heat sinks and allows you to probe the device while the chip carrier is in the socket.

The sockets spec 100g min normal force, 20-m $\Omega$  max contact resistance, 1-pF max capacitance, and 5000-M $\Omega$  insulation resistance. They operate over -55 to +85°C. \$0.065 per contact (5000).

**Elco Corp, Huntingdon Industrial Park, Huntingdon, PA 16652. Phone (814) 643-0700.**

Circle No 564

## DISPLAY ENCLOSURE

Designed for use in industrial environments, the Bayrack rack-mount adapter adapts Tektronix color graphics terminals to EIA-compatible rack-mount equipment. The aluminum adapter permits tilt adjustment and requires no modifications to the Tektronix terminal. It fits standard EIA front-panel dimensions

of 19×17.5 in. and provides a minimum rack depth of 22 in.

The keyboard drawer mounts below the adapter and requires 3.5 in. of rack height. The front panel's standard finish is black hard-coat anodized, but you can specify other colors to match existing rack colors.

Options for the adapter include chassis slides, a keyboard drawer, and an enclosure. The enclosure is for applications that do not require an instrumentation rack.

The manufacturer will satisfy custom design requirements, and it will also supply the rack-mount



adapter with the Tektronix terminal already installed. \$495 each for the adapter and optional enclosure. Keyboard drawer and slides cost \$149 and \$89, respectively.

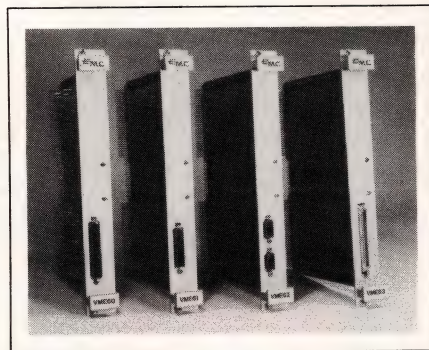
**Bay R & D Inc, Box 2517, Santa Barbara, CA 93102. Phone (805) 965-4913.**

Circle No 570

## PROTOTYPE PANELS

VME 60 Series wire-wrapping boards feature surface-mounted decoupling capacitors (in 0.33-, 0.1-, and 0.01- $\mu$ F values) at power and ground locations, which saves users time and money in board assembly. The prototyping boards also include peripheral I/O connectors, which are mounted on the boards' front panels.

A variety of connector styles are

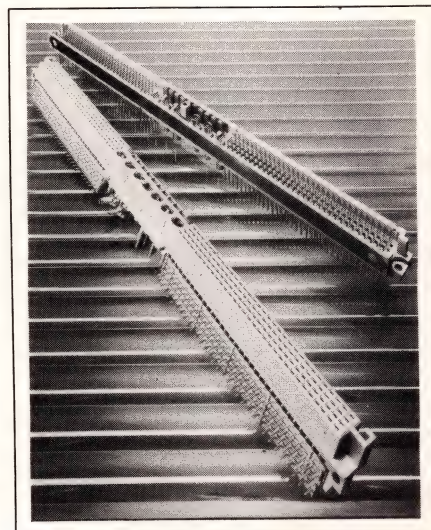


available for the front-panel I/O; they include a 37-pin, a 25-pin, and two 9-pin D subminiature connectors and a 40-pin ribbon-cable connector. The panels are designed with a high-density universal pin pattern that can accept devices with 0.3-, 0.4-, 0.6-, and 0.9-in. center-to-center spacings.

The precision-machined terminals on the VME 60 panels are available in styles that will accept either two or three levels of wrap. Plating options include gold, tin, or tin/lead. \$315 for a gold-plated panel.

**Electronic Molding Corp, 96 Mill St, Woonsocket, RI 02895. Phone (401) 769-3800.**

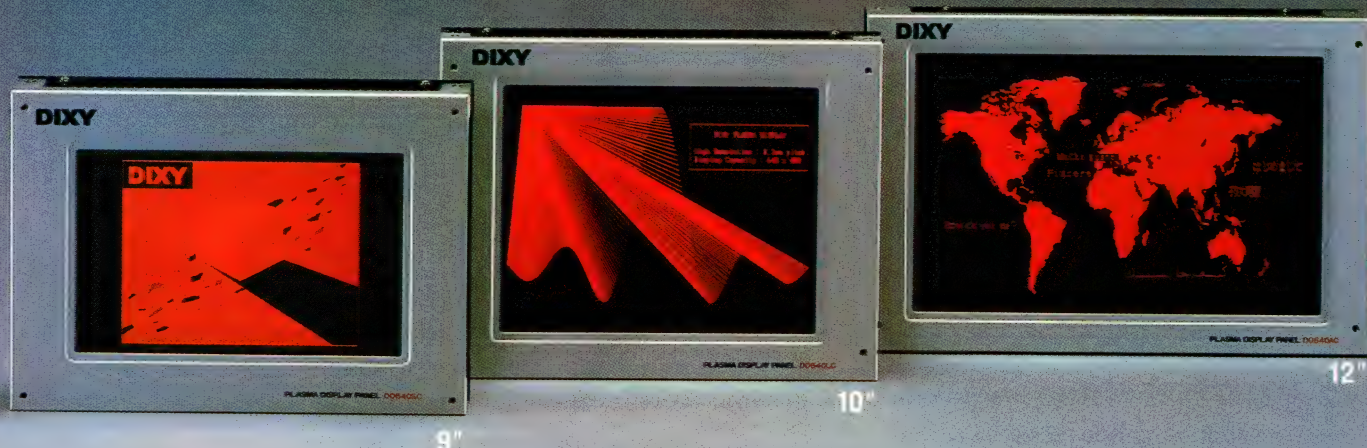
Circle No 566



## DIN 41612 CONNECTORS

By combining the two DIN 41612 connectors normally found on a double-Eurocard pc board into a single connector assembly, Siedecon insulation-displacement connectors (IDCs) can accommodate extra con-





## DIXY'S PLASMA DELIGHTS.

Our competitors think our new C and D Series plasma displays revolutionary. At DIXY, we consider them merely evolutionary. But then, we're known for our high-performance, cost-effective plasma panels with top-of-the-line specifications.

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- The other DIXY benefits. Responsiveness to your needs.

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- Thinner and simpler design (new C and D Series units), 19mm at the periphery, 38mm at the center.
- Adjustable brightness control.
- Lower power consumption.
- Value-added engineering for extra reliability and durability.

### DIMENSIONS

MODEL	SCREEN SIZE	WIDTH	HEIGHT	DEPTH
SC.SD	9"	276mm	197mm	38mm
LC.LD	10"	276mm	213mm	38mm
AC.AD	12"	325mm	216mm	38mm

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 KANEMATSU-GOSHO (U.S.A.) INC. HIGH-TECH DEPT. 543 W. Algonquin Road, Arlington Hgts., IL 60005 TEL: (312) 981-5693, FAX: (312) 981-9076, TLX: TWX (910) 687-284, WU-28-2438  
 CRAFT DATA INC. 27022 Cordero Lane, Mission Viejo, California 92691 TEL: (714) 582-8284, TLX: 751875 CRAFT DATA

CIRCLE NO 75



# Hardware and Interconnect Devices

connector contacts in their center section. The 1-piece connector molding also eliminates the need for a center support rail in the subrack's card cage. The connectors have an inverted DIN 41216 contact arrangement with straight tails on the male connector for insertion into the backplane, and right-angled tails on the female connector for mounting on the mating board.

In addition to offering a maximum complement of 256 AF contacts, which are distributed over the two 4-row $\times$ 32-contact areas at either end of the unit, the connectors are available with as many as six high-current or coaxial contacts in the center section. As many as four pre-mating contacts are provided in each of the two 4-row $\times$ 32-contact areas. For systems that require the boards to have unique slot positions on the backplane, you can install a 12-pin polarizing plate in the center section of the connector.

The connector tails are suitable for soldered, press-fit, or wire-wrapping assembly. Tails for wire-wrapping connection are coated with a PdAu surface over the wire contact area. Prices for connectors without special contacts range from DM 19 to DM 40, depending on the pin population.

**Siemens AG, Zentralstelle für Information, Postfach 103, 8000 Munich 1, West Germany. Phone (089) 2340. TLX 5210025.**

Circle No 565

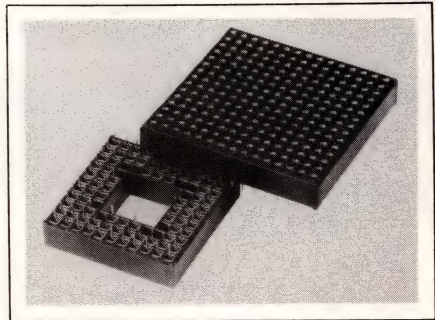
## PGA SOCKETS

The Series 9085 pin-grid-array (PGA) sockets accept standard and custom 0.1-in. centerline PGA-style ceramic chip carriers. Available in matrices of 10 $\times$ 10 to 15 $\times$ 15 pins with unlimited loading combinations, the sockets have a maximum mounted profile of 0.25 in.

The sockets accommodate arrays in the cavity-up or cavity-down position; the sockets have a variety of pin-polarizing options. The high-

temperature thermoplastic insulator sockets feature beryllium copper contacts that are selectively plated with gold in the contact area and with solder on the through-board tails.

Specifications for the sockets include 1.3-oz insertion force, 50g minimum normal force, 25-m $\Omega$  maximum contact resistance, and



## NO OTHER EL LAMP CAN HOLD A CANDELA TO OURS.

LSI electroluminescent (EL) lamps offer the designer a surface illumination alternative far superior to incandescent or other conventional light sources. And, whereas other makes of EL lamps may offer some of our product features, comparative tests prove that for long life, brightness, uniform light diffusion, color stability, resistance to moisture, heat, vibration and shock, no other EL lamps can match ours.

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These rugged, solid-state EL lamps provide cool, uniform light across the entire lamp surface, eliminating the need for sockets, bulbs, diffusers and reflectors. Power consumption is small due to low current demand. A thin profile (.032") permits high density packaging; and with IC-style leads available, lamps are compatible with PCBs. Although stocked in rectangular shapes for immediate delivery, we can design EL lamps in a variety of custom shapes and sizes including complex forms with

multiple holes and cutouts. Available with pressure-sensitive adhesive on front or rear surfaces.



If you'd like a copy of our brochure, or have questions regarding EL applications, just call, write or TWX the LSI Marketing Department.

**Luminescent  
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## EMCOR

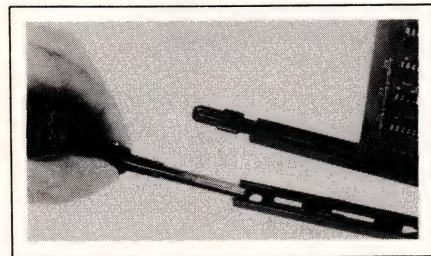


# Hardware and Interconnect Devices

$5 \times 10^9 \Omega$  insulation resistance. The parts have a dielectric withstanding voltage of 5000V dc, and they operate over  $-55$  to  $+85^\circ\text{C}$ . \$0.055 per position (5000). Delivery, eight to 12 weeks ARO.

**Elco Corp, Huntingdon Industrial Park, Huntingdon, PA 16652. Phone (814) 643-0700.**

Circle No 573



## CARD GUIDES

Designed to accommodate boards at least 6 in. long, Lok-Trak card guides have a card-locking feature that has multiple locking positions. By simply pushing the locking key in and against the pc board, you lock the card so that it can't move. To remove the pc board, you simply squeeze the key until the locking teeth disengage. The guides also have a spring-finger system that grips the pc board and provides shock damping and protection from vibration.

Snap-in buttons in the card guide let you insert the guide easily and quickly into prepunched holes in card cages or chassis, the manufacturer claims. Both the guides and keys are molded of strong, dimensionally stable polycarbonate plastic. \$0.49 to \$0.58 for a guide and key pair.

**Calabro Industries Inc, Unitrack Div, Box 1927, West Chester, PA 19380. Phone (215) 692-0800. TWX 510-663-0000.**

Circle No 569

## CLEAVE TOOL KIT

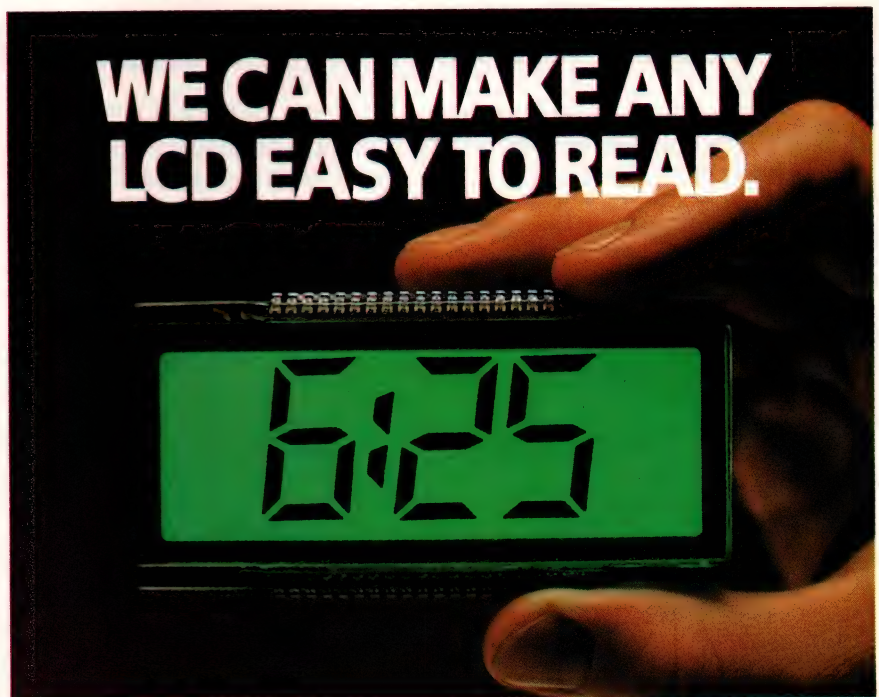
The BFT-101 universal cleave tool kit works with most optical fibers and connectors. It is supplied in a

rugged carrying case, and it contains a fiber-cleaving tool assembly and all the accessories necessary for performing clean fiber cleaves.

The tool has a solid metal frame with a ceramic alignment sleeve. If you use prestripped fiber, you can perform a cleave in seconds with the BFT-101, claims the manufacturer. The tool, which adjusts to accommo-

date fibers of different sizes, comes with calibration instructions.

The BFT-101 provides cleaved end faces with angles typically less than  $0.5^\circ$  from the perpendicular. You use a diamond stylus to scribe the fiber, which is under longitudinal tension. The stylus transfers energy into the fiber, causing it to break cleanly. The resulting mirror-



Our thin, flexible electroluminescent lamps dramatically improve LCD readout by providing higher contrast and better visibility. A thin profile (.032") allows high density packaging, and pressure-sensitive adhesive can be supplied on front or rear surfaces for rapid assembly.

**Uniform, cool light source in many shapes, sizes and colors**  
Our backlighting ELs emit even illumination across the entire lamp surface. They also eliminate the need for sockets, bulbs, diffusers or reflectors. Lamps are usually supplied in rectangular shapes, but we can create many custom shapes and sizes including complex forms with multiple holes and cutouts. With IC-style leads, lamps are compatible with PCB assembly. Eight standard colors are available and custom colors can be created.

If you'd like more information relating to LCD applications, just call, write or TWX the LSI Marketing Department.



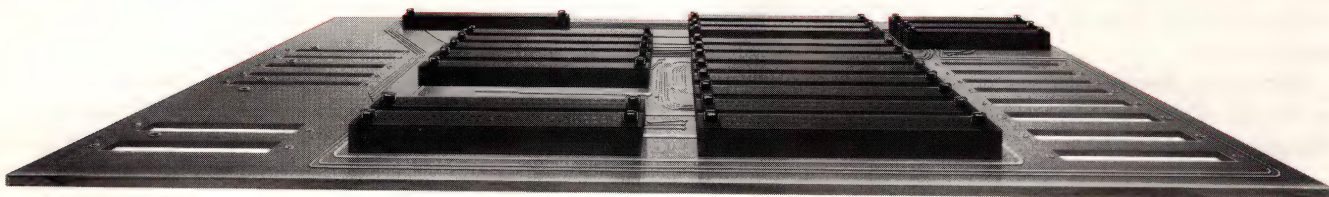
**Luminescent Systems Inc.**

Setting the Standard

Tel. (603) 448-3444 TWX 710-366-0607  
Etna Rd., Lebanon, NH 03766

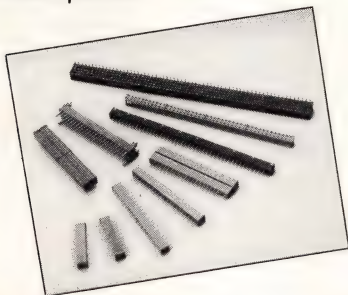


# THE BEST CONTACTS ACROSS THE BOARD...

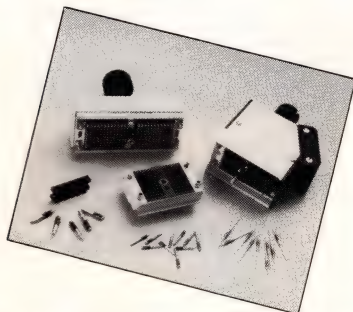


## LOW INSERTION FORCE HYPERTACS®

**H**ypertronics' connectors feature Hypertac®, a design innovation that satisfies requirements previously considered impossible. The essence is a hyperboloid shape formed by multiple wires that stretch and wrap around the mating pin to create multiple contact paths.

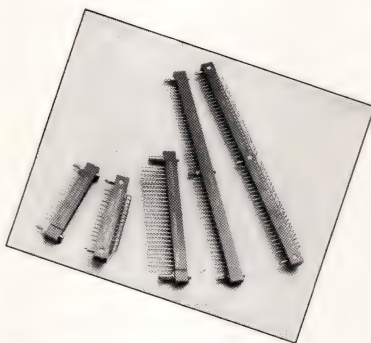


**KG Series—Sub-Miniature Low Profile LIF/PCB Connectors** • .100 x .100 grid from 22-90 positions • .240 height between parallel boards, sandwich style • Mother/daughter board, board to chassis and other applications • Inductance as low as 50% of comparable designs.

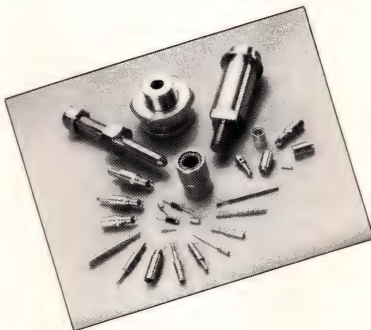


**N Series—High Density LIF Mini-Modular Connectors** • Design your own special connector from standard parts • 10 position—5 amp and 5 position—9 amp modules • Up to 700 contacts on a

.100 x .100 grid • Over 40,000 potential combinations for rack and panel, cable to chassis, and programming applications.



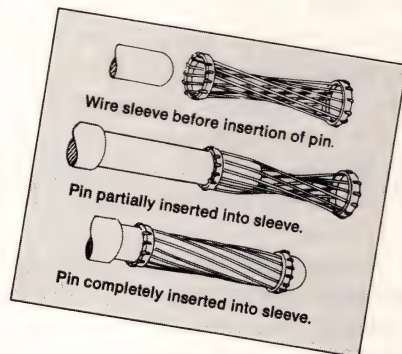
**KA Series—Sub-Miniature LIF/PCB Connectors** • The choice in demanding military and industrial applications • 17-320 position models with average contact insertion force of 1 ounce • Removable p.c., wire wrap, solder and crimp terminals • Integral guide and locking hardware.



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All Hypertronics connectors utilize the Hypertac® design, resulting in these unique characteristics:

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Customized designs featuring the Hypertac® contact are available from Special Products Division. For more information on these versatile connectors, call Toll-Free 1-800-225-9228 or write for a copy of our brochure, "New Horizons in Connectors."



**HYPERTRONICS CORPORATION**

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Hudson, MA 01749  
Telex: 95 1152  
1-800-225-9228  
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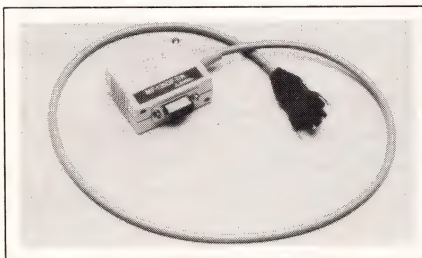
# Hardware and Interconnect Devices



finish surface makes end-face preparations such as polishing unnecessary. \$695.

**G&H Technology Inc.**, 750 W Ventura Blvd, Camarillo, CA 93010. Phone (805) 484-0543.

Circle No 571



## OPTICAL LINK

Designed for use in 802.6-standard token-passing, ring-configuration LANs, the MF-1250F-T/R Light-wave Transceiver combines a transmitter and receiver in one unit for full-duplex operation. The data link's peak optical wavelength is 850 nm, and its operating temperature range is 0 to 60°C.

The transceiver is available with either a terminated or an unterminated fiber pigtail. Its 5M-bps data rate and 10-dB loss budget combine to yield a maximum link length of 5 km. All I/O signals, power, and disable functions are available via a standard DB-9 electrical connector.

The MF-1250F-T/R is available with a variety of user-selectable pigtails, and can have any standard optical connector termination. A dual-position connector is also available. \$185 for an unterminated ver-

sion; \$285 for a terminated model.

**Mitsubishi Electronics America Inc.**, 1050 E Arques Ave, Sunnyvale, CA 94086. Phone (408) 730-5900.

Circle No 567

## I/O CONNECTOR

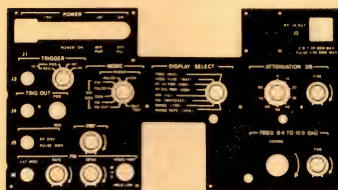
The Semconn 2-piece connector sys-

tem supports high-speed data bus-ing. The pc-board-mounted receptacle is molded of high-temperature plastic and shielded with tin-plated brass. The contacts are preloaded.

The positive-locking plug features redundant dual-point contacts. Made of clear polycarbonate and shielded with tin-plated brass, the plugs are capable of terminating ei-

# GIVE US .085" FOR AN ILLUMINATED PANEL NO ONE CAN MATCH.

At only .085" thick, our new fiber-glass electroluminescent panels are designed to replace lightplates and traditional metal plates that may not presently be illuminated. Our thin .085" panels weigh 40% less than a typical .220" plexiglass panel, and with an expansion coefficient equal to aluminum, the panels are ideal for surface-mount applications.



LSI electroluminescent panel

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LSI EL lamps eliminate the need for sockets, bulbs, diffusers or reflectors, and add no heat to the assembly. This, together with their long life and availability in many colors, make them the intelligent choice for panel illumination—far superior to LEDs or incandescent bulbs. We create panels (including standard .220" plexiglass) in almost any shape and size, as well as complex designs with multiple holes and cutouts. Lamps can be filtered to comply to ANVIS or other military specifications, or to your design requirements.

If you'd like a copy of our brochure, or have questions regarding panel applications, just call, write or TWX the LSI Marketing Department.

**Luminescent Systems Inc.**

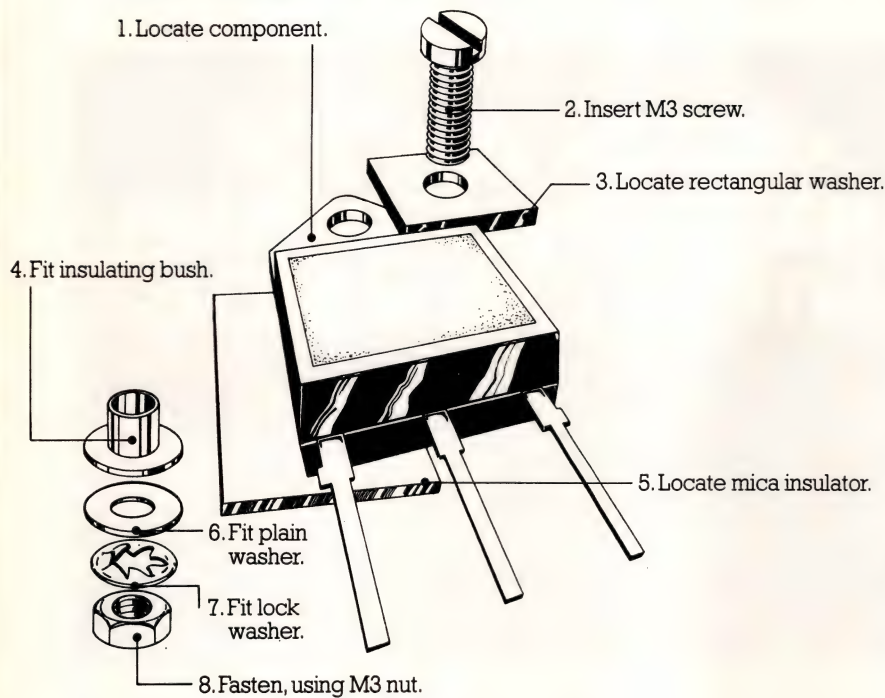
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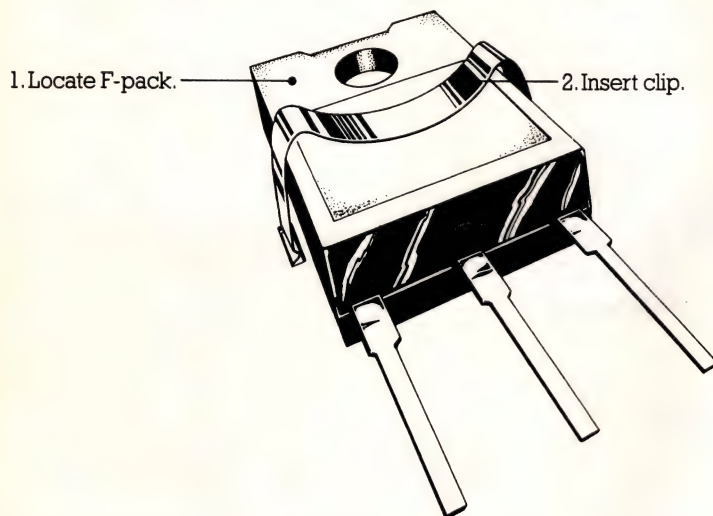


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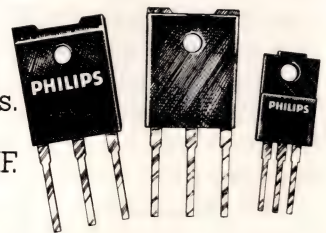
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**The name is Philips.**  
**The product is power semiconductors.**



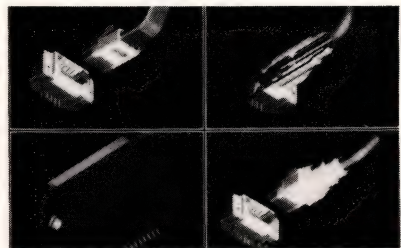
Electronic  
components  
and materials

CIRCLE NO 63

# PHILIPS



# Hardware and Interconnect Devices



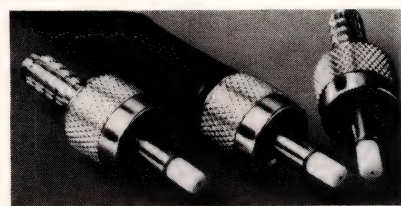
ther flat or round shielded cable.

The Semconn system is available in 6- and 8-contact versions. The contacts' ratio of insertion force to normal force is low, and they can carry 1.5A at 30V ac.

The manufacturer also offers an arbor press that uses insulation-displacement techniques to terminate the shielded cable to the plug. In one cycle, the machine performs the mass termination and sets two strain reliefs on the cable. \$1.60 and \$1.93 (1000) for an 8-position plug and a receptacle, respectively.

**Molex Inc, 2222 Wellington Ct, Lisle, IL 60532. Phone (312) 969-4550.**

Circle No 572



## F-O CONNECTORS

SMA-type 905 and 906 Series fiber-optic connectors owe their high performance to the use of ceramic ferrules and a special adapter. The connectors are designed for connector-to-connector and connector-to-active-device applications.

Typical insertion loss for the 905 units specs <0.3 dB for 100/140- $\mu$ m fiber and <0.6 dB for 50/125- $\mu$ m fiber. For the 906 connectors, typical insertion-loss figures for the same fiber sizes are <0.3 and <0.4 dB.

When you use the 905-120-5015 adapter with the connectors, return losses (back reflections in a mated pair of connectors) are typically bet-

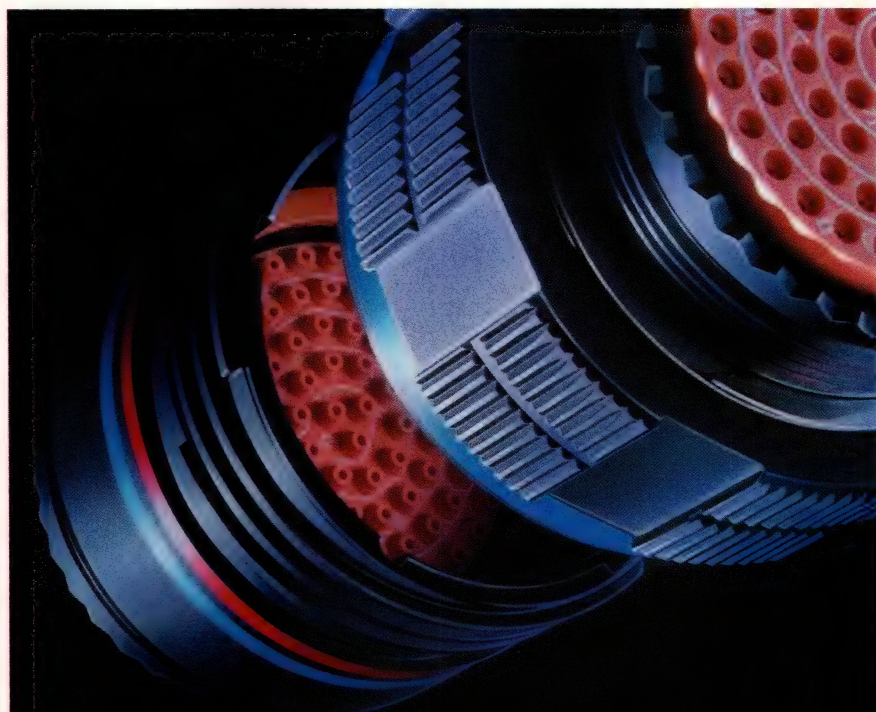
ter than 28 dB for 50/125- $\mu$ m fiber. Rotation sensitivity is 0.1 dB max in both connectors. Over the connectors' lifetime (1000 mating/unmating cycles), insertion loss in the 905 varies <0.1 dB for 100/140- $\mu$ m fiber and <0.2 dB for 50/125- $\mu$ m fiber; in the 906, insertion loss varies <0.1 dB.

Each connector has a stainless-

steel body, ceramic ferrule, and knurled coupling nut, and each comes preassembled. Also included in the package is a dust cap, a bend-relief boot, and a crimp-type ferrule. \$10 (OEM qty).

**Amphenol Products, 4300 Commerce Court, Lisle, IL 60532. Phone (312) 983-3500.**

Circle No 576



These days,  
our MIL-C-38999  
can do about  
anything.

If this connector doesn't look like your typical MIL-C-38999 Series III, it isn't.

This is an ITT Cannon 38999 Special whose modified shell has been finished in conductive black cadmium over nickel. It was specifically designed for a unique aerial/ground camera application.

Future possibilities are endless. If you have a custom application for the MIL-C-38999 connector, we're the Specials expert. The complete lines of our standard Series I, II and III are also available by calling Cannon direct.

Contact ITT Cannon Military/Aerospace, a unit of ITT Corporation, 666 E. Dyer Road, Santa Ana, CA 92702. Or call 714/557-4700.

**ITT CANNON**

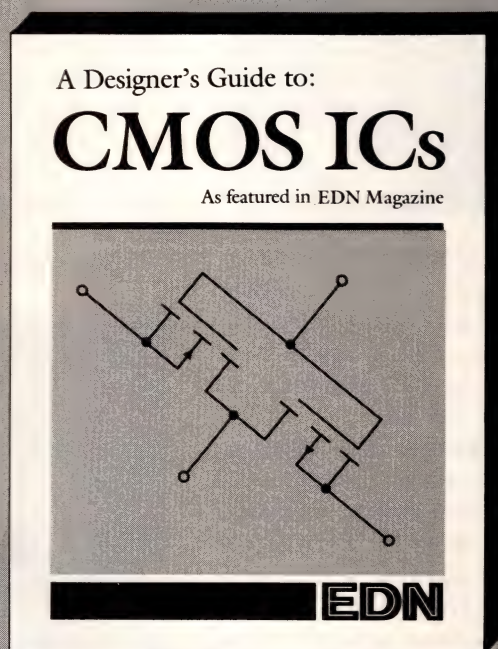
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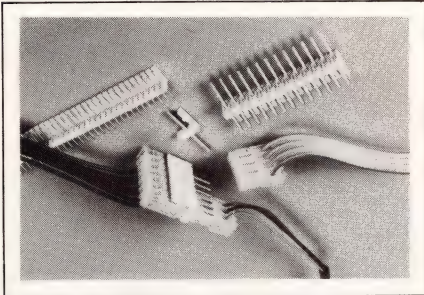


# Hardware and Interconnect Devices

## IN-LINE SPLICES

MWWS splices complement the manufacturer's MAS-CON IDC connector line. The splices accommodate either discrete wires or flat cable in applications that require no pc board.

The splices are available in versions having either 0.1- or 0.156-in. centerline spacing, and they're compatible with all MAS-CON products. The 0.1-in. models have two to 36 positions; the 0.156-in. units have



two to 24 positions. Each splice has a locking profile on one side; the other side has straight pins similar to those found on a straight pin header. From \$0.304 (1000).

**Panduit Corp, 17301 Ridgeland Ave, Tinley Park, IL 60477. Phone (312) 532-1800.**

Circle No 575

## OPTICAL CABLE

CP indoor/outdoor fiber-optic cable offers low-loss performance, weather and moisture protection, ruggedness, and halogen-free flame retardancy. The cable is suitable for use in building applications that require frequent cable reconfiguration. Models can have fiber counts ranging from one to 24. The individually jacketed fiber construction permits direct termination with all standard connector styles and doesn't require break-out boots or splice panels.

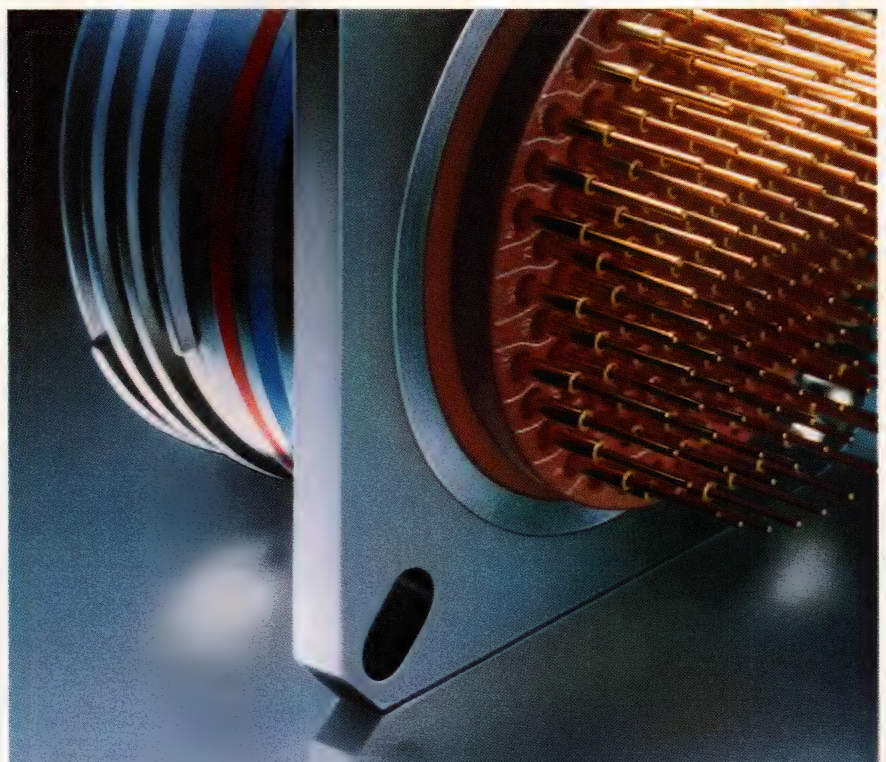
The cables' fiber can have core/cladding diameters of 50/125, 62.5/125, or 100/140  $\mu\text{m}$ . At 850 nm, the three types attenuate 3 to 3.5, 3.5 to 4, and 3.5 to 4.5 dB/km respectively, and their respective bandwidths are 400, 160, and 100 MHz-km. At 1300 nm, the cables' maximum attenua-



tion specs 1.5, 3, and 3.5 dB/km, respectively, and their bandwidths are 300, 500, and 100 MHz-km. \$2 to \$22.50 per meter, depending on fiber count, core/clad diameter, and quantity.

**Netek, 410 Gallimore Dairy Rd, Greensboro, NC 27409. Phone (919) 668-3353.**

Circle No 574



These days,  
our MIL-C-38999  
can do about  
anything.

If this connector doesn't look like your typical MIL-C-38999 Series III, it isn't.

This is an ITT Cannon 38999 Special whose shell has been modified to accept printed circuit board contacts for computer system and black box applications.

Future possibilities are endless. If you have a custom application for the MIL-C-38999 connector, we're the Specials expert. The complete lines of our standard Series I, II and III are also available by calling Cannon direct.

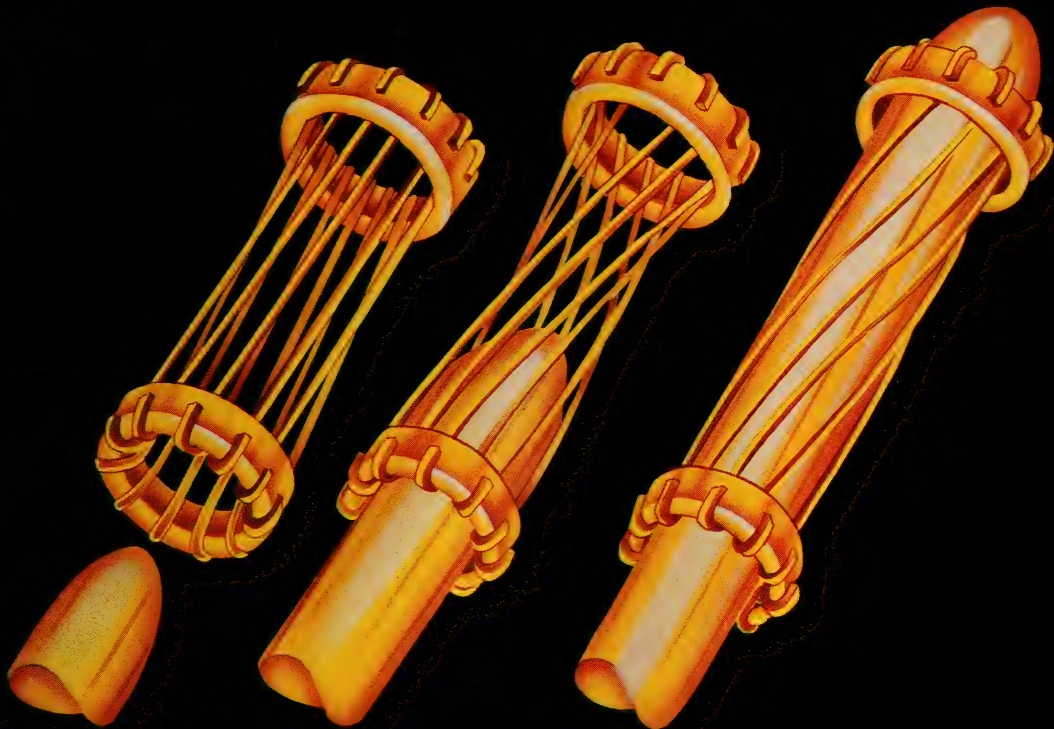
Contact ITT Cannon Military/Aerospace, a unit of ITT Corporation, 666 E. Dyer Road, Santa Ana, CA 92702. Or call 714/557-4700.

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Not excuses.*



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## MIL-C-55302

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- Front Release, Rear Removeable
- Immune to Shock and Vibration
- Available w/ 17, 29, 41, 53, 65, 72, 84, 96, 120, 160 Contacts



## HDO SERIES

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- Positive Locking Features
- High Cycle Life (25,000 + )
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- Available in 3, 4, 6, 7, 9 Contact Configurations



## HYPER/NAFI

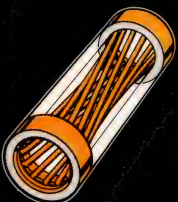
- 1.5 Oz. Insertion Force Per Contact
- Intermountable with MIL-C-28754
- Modular Design
- Immune to Shock and Vibration

**FOR INFORMATION CALL: MIKE HINTZ (813) 536-5933**

**CIRCLE NO 70**

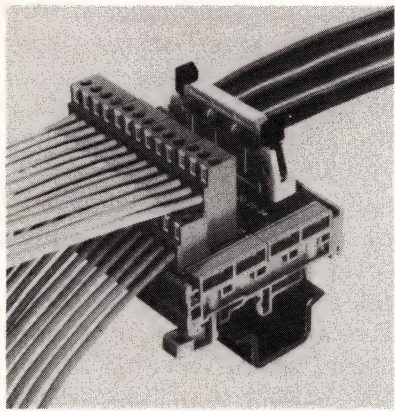
# **SI-TAC CONNECTORS, INC.**

**Building 209, 15251 Roosevelt Blvd., Clearwater, Florida 33520**  
**Telephone (813) 536-5933 Telex 808730**





# Hardware and Interconnect Devices



## TERMINAL BLOCKS

Series 20,000 modular terminal blocks allow direct interfacing between electronic cable and discrete wire as large as No 14 AWG. The terminal blocks are designed for DIN rail mounting. Each terminal block contains a circuit board, a board carrier consisting of standard spacer elements that snap together, side braces adapted to the length of the circuit board, and two DIN railings. The standard interface circuit boards connect discrete wire to 10- to 50-position IDC (insulation-displacement-connector) headers, 9- to 50-position male or female D sub-miniature connectors, octal and standard relay sockets, and diode matrices. All boards carry max current ratings of 1A/position.

The terminal blocks have a UL-recognized rating of 300V and 15A. The IDC header boards accept sockets equipped with standard 28 AWG flat-ribbon cable. \$65.97 (10) for a 50-position IDC header interface.

**Entrelec, 2 Ram Ridge Rd, Spring Valley, NY 10977. Phone (800) 431-2308; in NY, (914) 425-7460. TLX 996619.**

Circle No 577

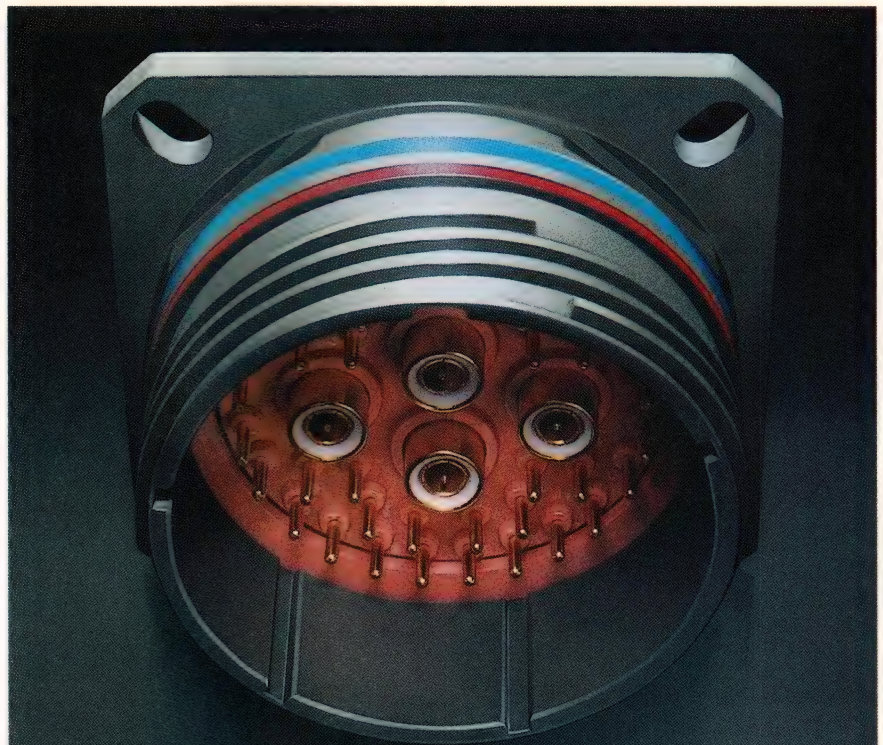
## BURN-IN SOCKETS

Series 635 and 636 burn-in sockets can test LCC (leadless chip carrier) and PLCC (plastic leadless chip carrier) devices, respectively. The sockets are designed for burn-in at 150°C, feature beryllium copper contacts plated with electro-nickel

or gold, and utilize body materials that have a 94V-0 UL rating.

The sockets' design allows easy manual or automatic loading/unloading of devices. You simply place the device on top of the socket and press down on the socket's sides; the carrier drops into place. High normal force holds the device in a contacts-up or contacts-down position.

The sockets' open-body construction provides even heat dissipation during testing. This feature also allows you to probe device contacts during testing. Series 635 units are available in 20-, 24-, 28-, and 68-position models. Series 636 units are available in 18-, 20-, 22-, 28-, 32-, 44-, 52-, and 68-position designs. \$7.81 (OEM qty) for a 44-position



**These days,  
our MIL-C-38999  
can do about  
anything.**

If this connector doesn't look like your typical MIL-C-38999 Series III, it isn't.

This is an ITT Cannon 38999 Special which has been modified to accept twin-ax contacts for MIL-STD-1553 data buss connector applications.

Future possibilities are endless. If you have a custom application for the MIL-C-38999 connector, we're the Specials expert. The complete lines of our standard Series I, II and III are also available by calling Cannon direct.

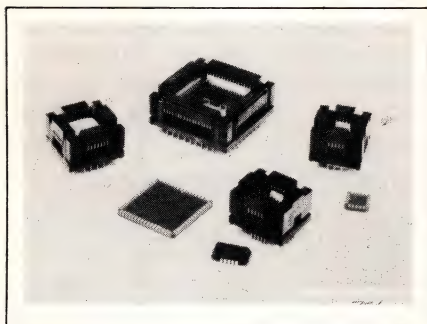
Contact ITT Cannon Military/Aerospace, a unit of ITT Corporation, 666 E. Dyer Road, Santa Ana, CA 92702. Or call 714/557-4700.

**ITT CANNON**

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Not excuses.*



# Hardware and Interconnect Devices



Series 636 socket with electro-nickel-plated contacts. Delivery, six weeks ARO.

**Wells Electronics Inc, 1701 S Main St, South Bend, IN 46613. Phone (219) 287-5941.**

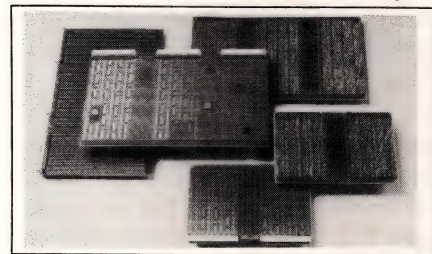
Circle No 579

## PROTOTYPING BOARDS

Suitable for the prototyping of high-

speed circuitry, this range of wire-wrapping boards features 4-layer construction with three independent voltage planes and a ground plane. An additional boost to high-speed performance stems from the use of 0.047- $\mu$ F surface-mount capacitors, which are preassembled onto the boards to provide local decoupling and charge storage.

The boards are available in six Eurocard sizes, from 100×160 mm to 366.8×280 mm, and they are pre-fitted with DIN 41612 connectors. All double- and triple-Eurocard versions incorporate areas of board where you can mount pin-grid arrays. The boards accommodate 0.3-, 0.4-, 0.5-, and 0.6-in. DIPs, and you



can mount a variety of surface-mount packages using special adapters. Adapters are available for 28-, 44-, 68-, and 84-pin quad packs, and for 44-, 68-, and 84-pin grid arrays. Fully populated versions of the prototyping boards cost £70 to £560, with adapters priced from £4 to £18.

**Bicc-Vero Electronics Ltd, Flanders Rd, Hedge End, Southampton, Hampshire SO3 3LG, UK. Phone (04215) 66300. TLX 477984.**

Circle No 582

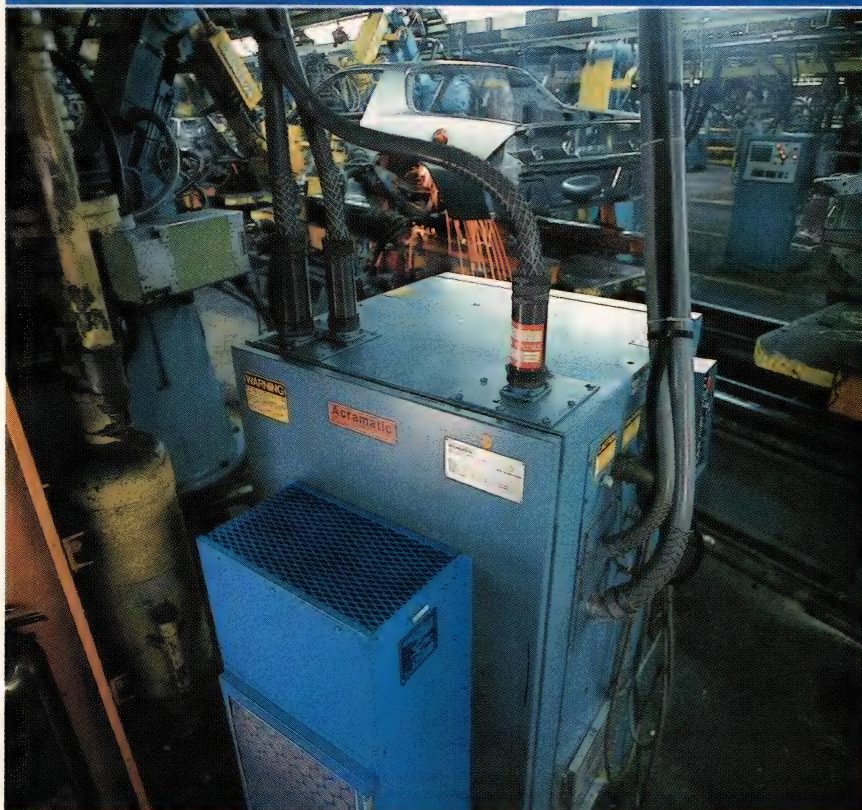
**Bicc-Vero Electronics Inc, 40 Lindeman Dr, Trumbull, CT 06611. Phone (203) 372-0038.**

Circle No 583

## ENCLOSURES

Designed to house IBM PC/XTs, PC/ATs, or compatible computers, Models RME-900 and RME-100 19-in. rack-mount enclosures offer EMI protection in industrial environments. The enclosures provide easy access to all cards, filtered air cooling, and rear I/O connector panels. They have an 8-card capacity.

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Climate Controllers for Electronics

# McLEAN MIDWEST

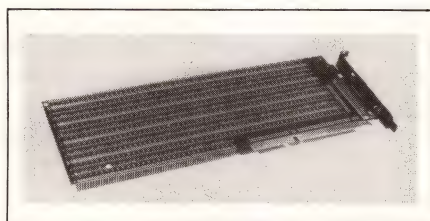


# Hardware

Model RME-900 includes a 9-in. monochrome monitor and provides mounting space for one full-height or two half-height hard-disk drives and a half-height floppy-disk drive. Model RME-100 has no monitor but can accommodate combinations of floppy-disk drives, hard-disk drives, and tape drives. It has room for two full-height and two half-height 5¼-in. drives. RME-900, \$625; RME-100, \$495.

**Recortec Inc, 275 Santa Ana Court, Sunnyvale, CA 94086. Phone (408) 737-8441.**

Circle No 580



## PROTOTYPE PANELS

These IBM PC/AT- and PC/XT-compatible, wire-wrappable panels are available with or without an uncommitted pin-grid-array (PGA) pattern. In addition, they feature surface-mount capacitors (the user specifies the value) at each voltage and ground location.

The panels are designed with a high-density universal grid pattern that's capable of accepting devices having leads on 0.3-, 0.4-, 0.6-, and 0.9-in. centers. The optional PGA section features an 18×40-location universal grid that accommodates standard PGA sockets. The panels' terminals accommodate either 2- or 3-level wrapping and gold, tin, or tin/lead plating. \$258.52.

**Electronic Molding Corp, 96 Mill St, Woonsocket, RI 02895. Phone (401) 769-3800. TWX 710-387-1350.**

Circle No 591

## DC FAN

The Multifan-4314 is a 119×119×32-mm brushless dc fan capable of delivering an air flow of 170 m³/hour. Specified for 24V nominal opera-

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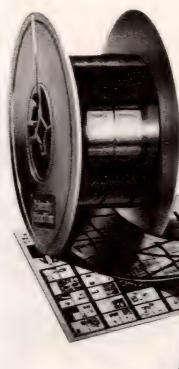


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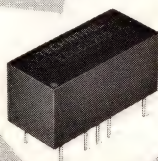
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# Hardware and Interconnect

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and Mil-T-27 components)

8183

tion, the fan actually runs on supplies in the 12 to 28V range. At 24V it runs at 2800 rpm and consumes 5W. By utilizing an aerodynamically optimized fan housing and rotor, molded from lightweight, fiberglass-reinforced Pohan and Ultramid plastics, the fan achieves a noise level in free air of 43 dB, rising to 45 dB under optimum conditions.

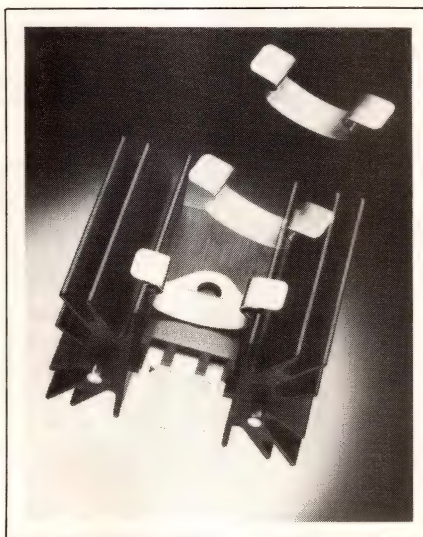
The fan operates over an ambient temperature range of -10 to +75°C, and it has a life expectancy of 25,000 hours at the maximum ambient temperature. The fan weighs 7.8 oz (220 grams). It's constructed according to VDE 0730 regulations; CSA, UL, and VDE safety approval is pending. Approximately \$11 (1000).

**Papst Motoren GmbH, Box 1435,  
7742 St Georgen, West Germany.  
Phone (07724) 811. TLX 792413.**

Circle No 584

**Papst Mechatronics Corp,  
Aquidneck Industrial Park, New-  
port, RI 02840. Phone (401) 849-  
8810.**

Circle No 585



## HEAT SINKS

Low-profile spring clips are a key feature of the Series 5334-36 extruded heat sinks. These clips allow you to mount semiconductors much more rapidly than is possible with the screw and nut method. The flush-mounted clip holds the transis-

tor firmly onto the heat sink, applying even pressure to eliminate gaps between the devices.

The heat sinks provide as much as 20W of power dissipation (natural convection) to cool plastic power devices (TO-218 and TO-220 units). Each heat sink can also be supplied with clips on both sides so that you can mount two semiconductors on it.

The heat sinks are available in 1.5-, 2-, and 2.5-in. heights. For vertical mounting, they're furnished with two solderable pins. Optional shoulder pins separate the heat sink from the pc board, so circuit traces can pass under the heat sink. \$0.795 (1000) for a 2-in. unit.

**Aavid Engineering Inc, Box 400,  
Laconia, NH 03247. Phone (603)  
524-4443.**

Circle No 578

## STRIP SWITCH

A sensor that incorporates a pressure-sensitive conductive-rubber (PCR) strip lets you form special linear switches. The PCR strip acts as a variable-resistance layer between two braided-wire electrodes that form the contacts of the NO switch. The typical insulation resistance is at least 100 MΩ at 500V dc. When compressed, the resistance between the electrodes decreases rapidly to 1Ω or less. Maximum current through the switch is 300 mA, and the switch handles 30V dc. You can specify the switch in any length and in several standard configurations.

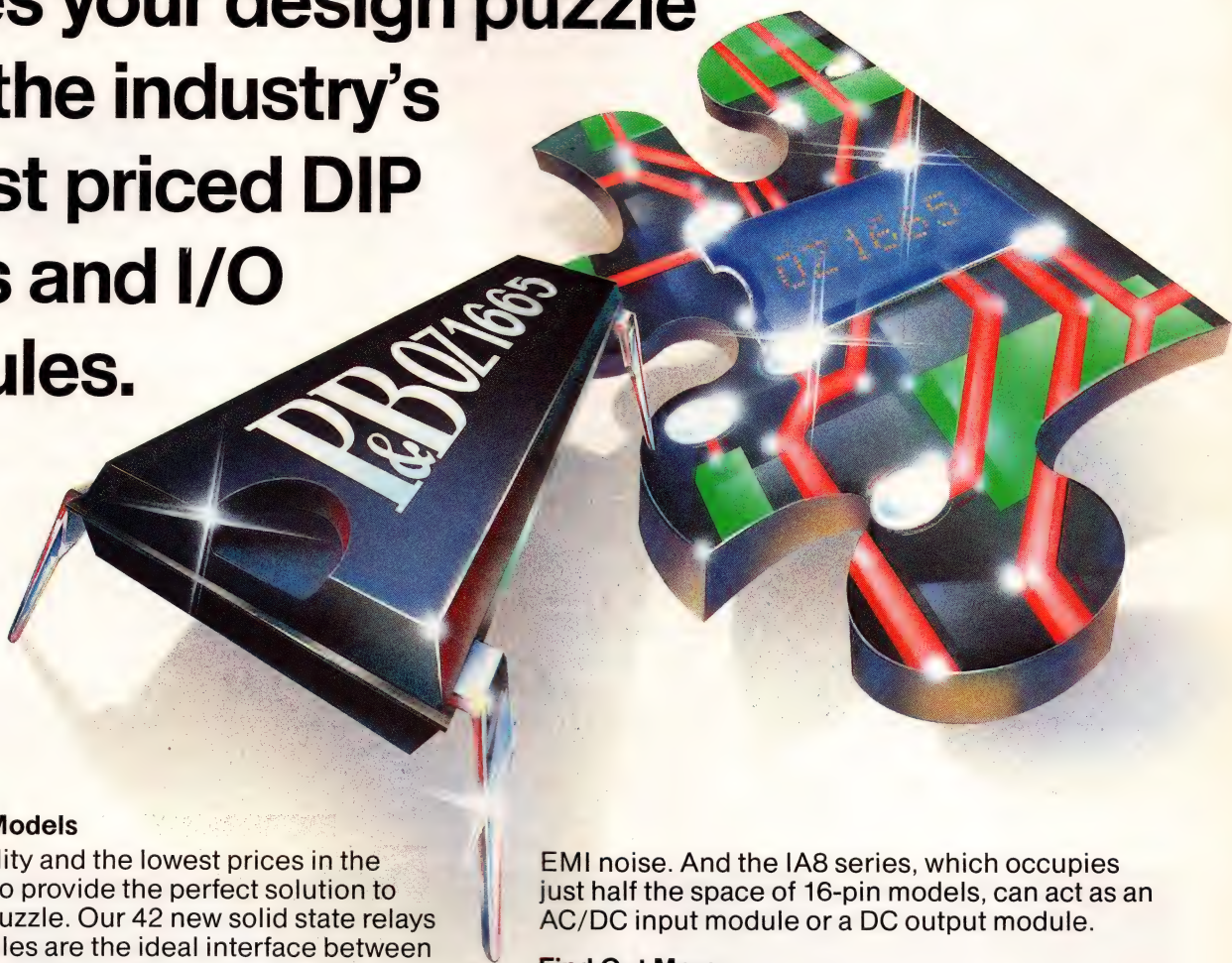
The manufacturer supplies mounting channels that secure the switch strip to a surface. You can also use adhesives to attach the strip to edges and surfaces. Typical applications include safety switches, load-sensing mats, and control switches. Samples are available for \$26 per meter.

**Bridgestone Corp, 10-1, Ky-  
obashi 1-Chome, Chuo-ku, Tokyo  
104, Japan. Phone (03) 567-0111.  
TLX J22217.**

Circle No 588



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**Regional Sales:** Braintree, MA, (617) 848-6550; San Juan Capistrano, CA, (714) 493-4503; Princeton, IN, (812) 386-2130.



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Potter & Brumfield Inc.,  
200 S. Richland Creek Dr., Princeton,  
IN 47671-0001

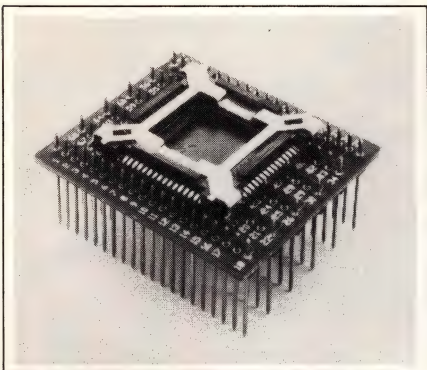
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# Hardware and Interconnect Devices



## ADAPTERS

Series ANC-9068 and -9084 adapters let you wire-wrap prototypes of designs employing LCCs or pin-grid-array (PGA) devices. Models -9068 and -9084 accommodate 68- and 84-position devices, respectively.

The adapters, which each occupy less than 4 in<sup>2</sup> of board space, provide labeled test points for each pin, thus facilitating the attachment of scope probes during the testing process. The wire-wrappable pins are

on 0.3-in. centered rows, so you can use the adapter on a wide variety of prototype panels. ANC-9068, \$49; ANC-9084, \$58.

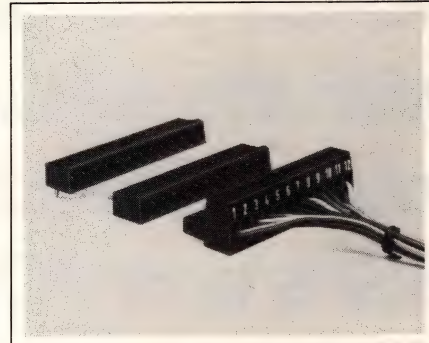
**Antona Corp, 2100 S Sawtelle Blvd, Suite 205, West Los Angeles, CA 90025. Phone (213) 473-8995.**

Circle No 581

## CONNECTORS

Series 8113B polarized plug and socket connectors meet UL 94V-0 flammability requirements and have a VDE 0110 grade B rating. Designed to mount flush with a pc board, thus preventing stress on the pins' solder joints, the plug connector has a locking tab to protect it against vibration and shock.

The connectors are available in either horizontal or vertical versions having two to 24 positions. They're rated for 300V at 10A or 250V at 15A, and they accept wire sizes ranging to No 12 AWG. The stand-



ard color is black.

The contact springs and solder pins are tin-plated bronze. The pressure clamp and screw assembly are nickel-plated brass. The terminal screws are captive; when tightened, they're secured against self-loosening. Braking action protects the conductor wire from excess pressure. \$5.16 (1000) for a 12-position plug/socket connector.

**Electrovert Inc, 466 Main St, New Rochelle, NY 10801. Phone (914) 633-0222.**

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Giving shape to imagination.



Extra cable means increased costs, decreased efficiency and increased stowage problems.

With Space-Mizer™ you don't buy any more cable than you really need.

**NEW!**

Space-Mizer™  
from  
Woven Electronics

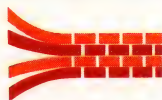
Until now, if you needed a 20 inch twisted pair IDC cable you had to buy 36 inches. If you needed a 10 inch cable you had to buy 18. As the old saying goes, "That's the way it was."

Not any more. Woven Electronics is proud to announce the introduction of Space-Mizer™ cable. Using the superior qualities of our patented CIC design and combining it with state-of-the-art materials, we have developed a quasi-twisted pair cable easily terminated with IDC connectors.

Space-Mizer™ has great electricals, flexibility, routability and durability. Best of all it can be terminated at any length. Never again will you be required to buy more cable than you really need.

# The bottom line:

The shortest distance between two connectors is Space-Mizer™.



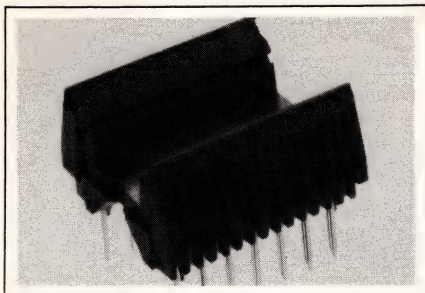
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# Hardware and Interconnect Devices



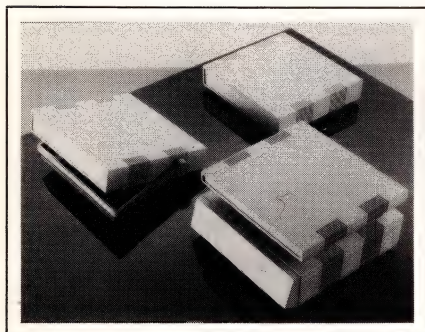
## SOIC SOCKET

Series 617 SOIC burn-in sockets are available in 16- and 28-lead versions. They allow fully automatic loading and unloading of surface-mount gull-wing devices. The sockets have spring-loaded side walls that swing outward to permit easy insertion and withdrawal of ICs.

The sockets hold ICs in the contacts-down position so the ICs can be probed while they're in the sockets. The stainless-steel contacts are selectively plated with 30  $\mu$ in. of gold to accommodate burn-in at temperatures as high as 200°C. The sockets are molded of glass-filled polyarylsulfone. Staggered contact tails provide a 0.1×0.1-in. pinout spacing to maximize layout density and accommodate standard layout patterns. The 16-lead version measures 0.45×0.40×0.47 in. and costs \$2.40 (production qty). Delivery, six to eight weeks ARO.

**Wells Electronics Inc, 1701 S Main St, South Bend, IN 46613. Phone (219) 287-5941.**

Circle No 589



## CASES

Proteus instrument cases are 275 mm wide and 250 mm deep and are available in heights of 25, 50, 75,

and 100 mm. The cases are constructed from ABS plastic in a light- and medium-gray color combination. You can fit the case with a molded-plastic, sloping front panel, or with a screw-mounted or slot-mounted, anodized-aluminum front panel.

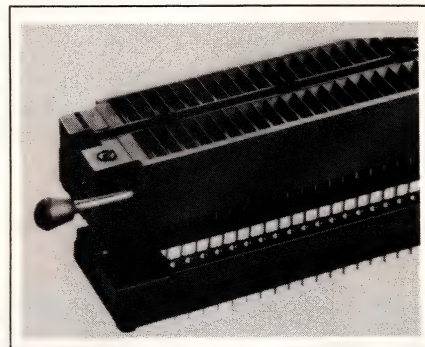
Internally, the cases are equipped with horizontal card guides that accept 160- or 220-mm-deep double Eurocards. Vertical card guides are also provided in the case's side walls. Four self-adhesive pc-board mounting clips and a set of molded, nonslip feet, which allow you to stack the cases, are also provided. Options include a tilt-and-swivel carrying handle for the 50-, 75-, and 100-mm-high cases, and an anodized-aluminum chassis plate for mounting off-board components. £11 to £18.

**Bicc-Vero Electronics Ltd, Flanners Rd, Hedge End, Southampton, Hampshire SO3 3LG, UK. Phone (04215) 66300. TLX 477984.**

Circle No 586

**Bicc-Vero Electronics Inc, 40 Lindeman Dr, Trumbull, CT 06611. Phone (203) 372-0038.**

Circle No 587



## TEST SOCKETS

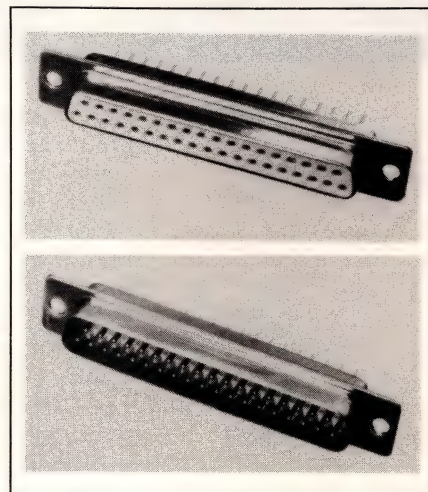
These ZIF sockets can accommodate the latest 32- and 48-pin ICs for test and burn-in procedures. Each socket has a very broad contact area, so the same socket can handle devices that have different lead widths (from 0.015 to 0.045 in.) and spacings (on 0.3-, 0.4-, or 0.6-in. centers).

The standard socket contacts are gold- or tin-plated beryllium copper, but other platings and base metals are available for burn-in applications above 150°C. The contacts are normally closed, providing consistent force and preventing contact deformation from oversized leads.

You can mount the sockets directly on pc boards or in a receptacle (available from the manufacturer) that has collet-type contacts. You can bolt the receptacle to the board alone or bolt the receptacle and socket together. Housings for both the socket and receptacle are UL 94V-0 rated. \$4.97 (100) for a 32-pin tin-plated socket; \$3.90 (100) for a 32-pin receptacle.

**Aries Electronics Inc, Box 130, Frenchtown, NJ 08825. Phone (201) 996-6841.**

Circle No 590



## D-TYPE CONNECTORS

Type CD subminiature D-type connectors have stamped contacts, so they cost less than do similar connectors with machined contacts, according to the manufacturer. Rated for an operating life of 50 connect/disconnect cycles min, the stamped contacts are permanently embedded in a thermoplastic body.

The male and female connectors are available with 9, 15, 25, or 50 contacts. The connectors comply with most industry standards and are interchangeable with all indus-



# Without the right channel connections, you won't break any system speed records.

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# Hardware and Interconnect Devices

try-standard subminiature connectors. The connectors are available in solder-cup, pc-board-tail, and right-angle pc-board types. The contact material is copper alloy plated with hard gold over nickel. The metal outer shell is zinc-plated steel. The connectors operate over  $-55$  to  $+125^{\circ}\text{C}$ . \$0.94 (1000) for a 25-contact female connector with solder-cup terminals.

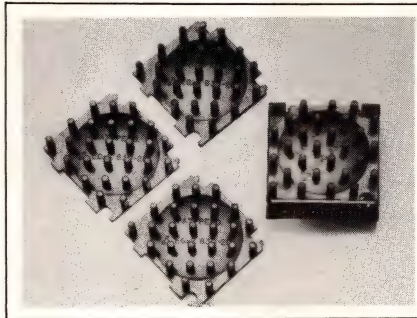
**Amlan Inc, 97 Thornwood Rd, Stamford, CT 06903. Phone (203) 322-1913. TLX 643647.**

Circle No 592

## HEAT SINKS

Series 830 pin-finned heat sinks are designed to mate with LSI devices. They provide omnidirectional cooling, so they offer better heat-dissipation performance than do extruded and stamped devices, according to the manufacturer.

The heat sinks are manufactured



to very close tolerances to ensure uniform pressure on the chip. Each heat sink has a flat surface at the chip interface, and it minimizes chip movement during socket installation. You can bond the heat sink to an LSI device by using a thermally conductive epoxy. You can also attach it directly to Textool's JEDEC Type A 68-position chip-carrier socket. \$0.80 (25,000).

**EG&G Wakefield Engineering, Components Div, 60 Audubon Rd, Wakefield, MA 01880. Phone (617) 245-5900. TWX 710-348-6713.**


Circle No 594

## SPLICE KIT

The NSK-7, a fiber-optic splice kit, provides the tools needed for high-performance UV-cured splices. The kit includes an instruction manual, a cleaving tool, a splice holder, a splice lamp, syringes, simplex cable, splice housings, a 30X microscope, an X-acto knife, a cable stripper, buffer strippers, tweezers, scissors, Texwipe cleaning pads,



# When it comes to Surface Mount Connectors,



# EDAC INC. offers you more than just bent contacts.



EDAC INC., 20 Rainside Road,  
Don Mills (Toronto) M3A 1A4  
Tel: 416-445-2292 TWX 610-492-1398

Edac's innovative surface mount connectors have been designed to save you circuit space and critical time. Edac's unique solder bushing mounting feature offers you four important advantages:

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3. Provides additional mounting integrity.
4. Provides for easy Back-to-Back mounting on your PC board.

Now, you can save 50% of space and eliminate costly

"through holes" because this unique surface mount connector has been specifically designed for use with vapor phase or infra red reflow soldering techniques.

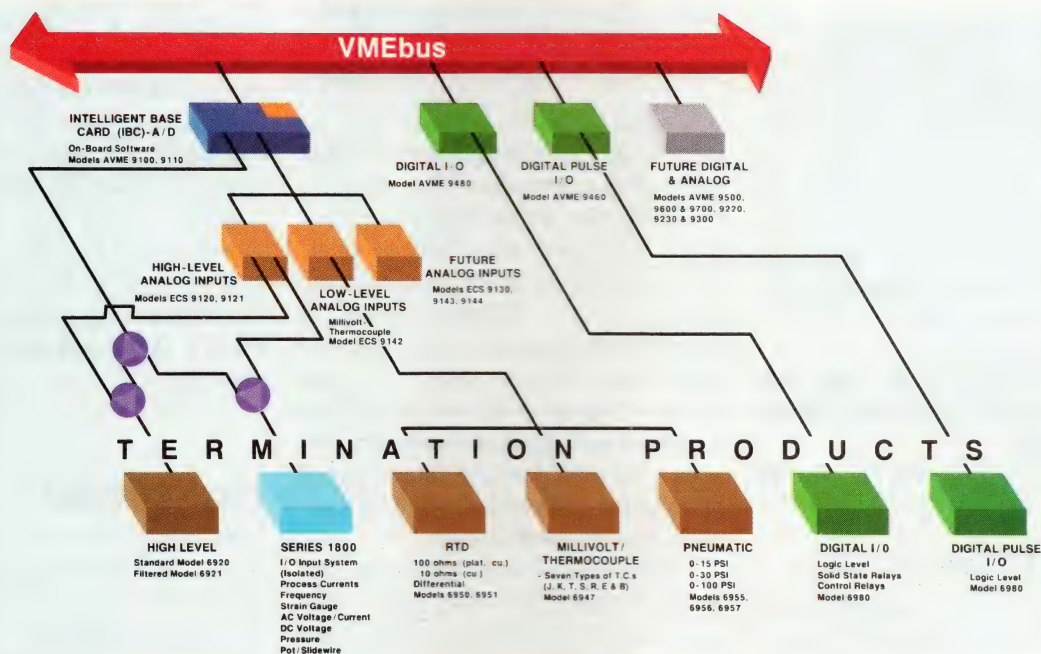
To help further control your quality, Edac's "J" wing termination allows for maximum solder fillets, full visual inspection and instrumentation test points. Available in 6-38 pins.

Technical data brochure, and sample connectors are available free. Please contact Edac.



# EASY AS IBC

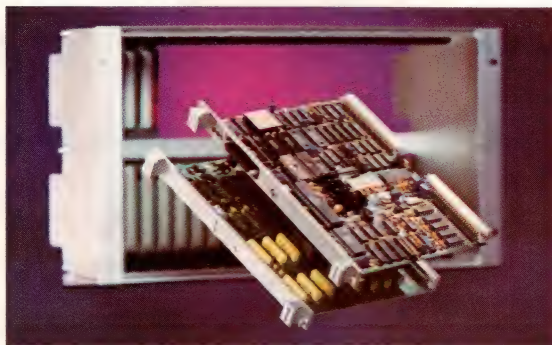
## Advanced VME industrial I/O capability



VME-Industrial I/O signal interfacing is now a simple matter of "putting it on the bus." Thanks to Acromag's analog and digital cards and termination products for interfacing real world I/O signals.

Field inputs such as thermocouple, RTD, voltage, frequency, strain gauge, pneumatic and many others are directly interfaced via screw type termination products and I/O cards to the VMEbus—as easy as IBC.

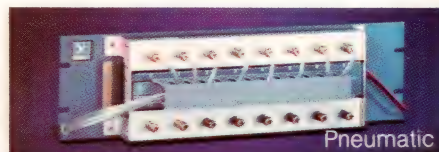
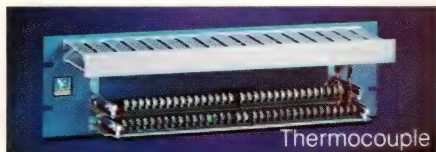
The Analog Intelligent Base Card (IBC) simplifies the problem by forming an intelligent base for the analog subsystem collecting and conditioning up to 256 analog signals and



storing all in dual port RAM memory. The IBC and analog I/O cards provide for 14-bit A/D conversion, amplification, isolation, scaling, linearization and limit checking. The IBC card also has a local serial port for calibration, diagnostics and configuration.

And digital I/O? Of course... provided for by a 64 channel 30 volt bi-directional I/O card with or without relay field interfaces using a variety of screw type termination panels.

Acromag's VME cards and termination products provide the broadest industrial I/O capability available. All to make solutions to your industrial I/O needs as easy as IBC.



# Acromag

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EDN December 11, 1986

CIRCLE NO 80

To find out more about Acromag's VME Industrial I/O capability and commitment write for Bulletin 20-000.0. Or for immediate help call our telemarketing department at 1-800-ACROMAG or (313) 624-1541.



113



# Hardware and Interconnect Devices

masking tape, and 10 of the company's UVC optical splices.

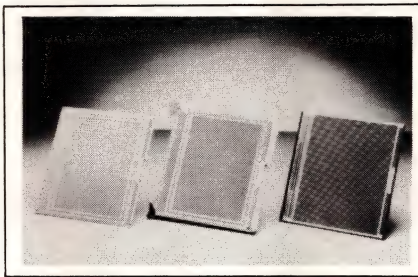
All these supplies come in a lockable carrying case. The UVC splice is a 1-piece glass device for field and lab use. The splice process has two steps. First, you fill the splice with UV-curing optical adhesive. Then you insert and cure the fibers. The kit is designed for both single- and multimode fibers having 125- to 140- $\mu$ m outside diameters. Complete splices have an average light loss of 0.2 dB and withstand temperatures from -40 to +70°C. \$1190.

**Norland Products Inc, Box 145, New Brunswick, NJ 08902. Phone (201) 545-7828.**

Circle No 596

## PROTOTYPING BOARDS

These Eurocard prototyping boards have a 0.1-in. universal grid pattern and can accommodate any IC on a



0.1 $\times$ 0.1-in. grid in either vertical or horizontal orientation. This flexibility allows for nonrestrictive placement of components. Twelve models are available in sizes ranging from 160 mm $\times$ 3U to 400 mm $\times$ 9U. Each board's bus-connector area accepts right-angle, 96-pin wire-wrap connectors that allow direct connection to power and ground buses; the I/O area provides for the mounting of D-subminiature and 0.2 $\times$ 0.1-in. flat-ribbon-cable connectors.

Three signal-area patterns are available: pad per hole, buses only (power and ground buses follow the perimeter of the card), and power

and ground plane (one side of the board is covered with a ground plane and the other side is covered with a power plane). The boards use eyelets to commit power and ground to connectors by soldering. You can use the same eyelets to connect the power and ground foils anywhere on the board surface. Individual drilled holes in the power and ground foils have isolated rings around them to prevent inserted leads from shorting. \$15 to \$39.

**Vector Electronic Co, 12460 Gladstone Ave, Sylmar, CA 91342. Phone (818) 365-9661. TWX 910-496-1539.**

Circle No 598

## CONNECTORS

DMC connectors are rectangular types that use sealed, crimp-type contacts. The devices' MIL-C-39029/22 contacts release in the rear. The connectors are available in plug-

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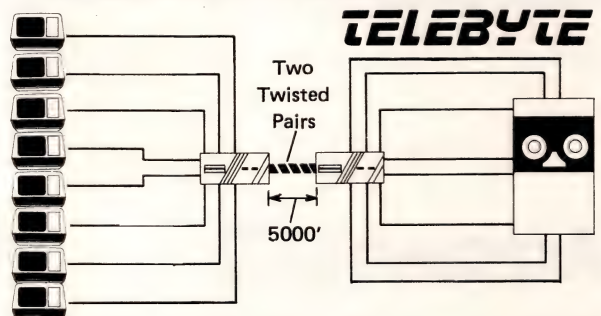
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CIRCLE NO 82



# Just when you thought all peas were alike...

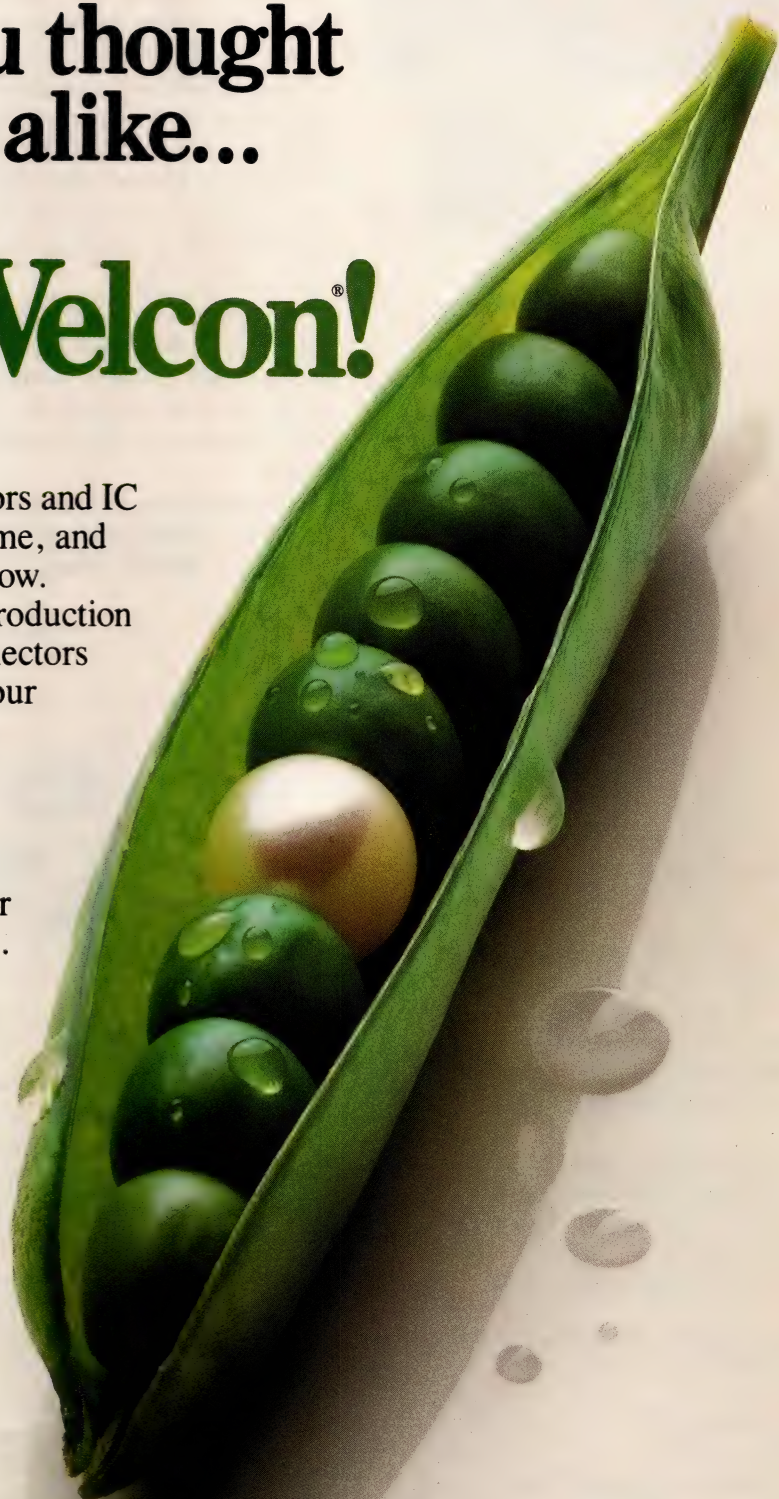
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The truth is, virtually all connectors and IC sockets cost the same, look the same, and perform the same. We ought to know. Welcon has been manufacturing production sockets, burn-in sockets, and connectors for years. We've had to carve out our niche in the marketplace by being different; by working closer with our customers than some of our larger competitors.

We know that a connector supplier must provide exemplary service... for service is what keeps our old customers, and what gets our new customers. Service with Welcon means greater flexibility, closer relationships, greater responsiveness... in other words, a healthy working partnership.

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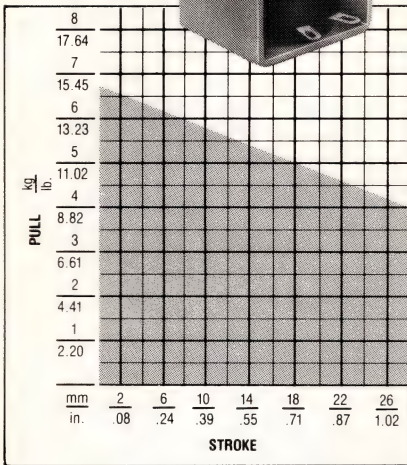
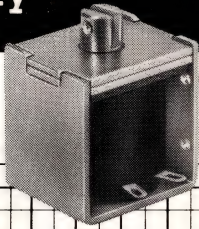
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# Hardware and Interconnect

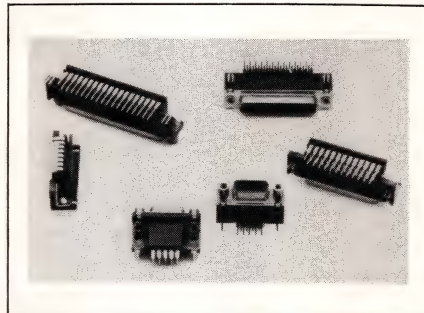
and-cable or box-mounted receptacles that contain four side-by-side, mounted, sealed modules containing the contacts.

Two insertion arrangements are available: Module 40 features 10 size 22 contacts, and Module 44 contains two size 16 and two size 22 contacts. The maximum current rating for the size 22 contact is 5A; for the size 16 device, it's 13A.

The connectors operate over  $-55$  to  $+175^{\circ}\text{C}$ , and their coupling durability is 250 cycles. The contacts are a gold-plated copper alloy. \$60 to \$150. Delivery, six to eight weeks ARO.

**Deutsch Engineered Connecting Devices, Municipal Airport, Banning, CA 92220. Phone (714) 849-7822.**

Circle No 595



## CONNECTORS

You can insert these D-subminiature 0.59-in. metal-shell connectors, which have grounding brackets, directly onto a pc board. The connectors furnish a continuous grounding path from the shell to the pc board. The five available configurations differ in grounding techniques: The DG style uses a solder tail to align the first row of contacts; the LG type also aligns the first row, but does so with a lock pin. The SG style uses the lock pin but goes through the mounting hole, and the TG is a top-ground style, which uses mounting screws to ground the connector to the board. In the BG version, a recessed strap runs under the D-subminiature connector and terminates at the mounting hole.

The connectors come in through-

hole, flush-threaded-insert, hex-standoff, and round-standoff mounting styles. The company offers 9-, 15-, 25-, and 37-position receptacles. The connectors are UL listed and CSA certified, and they employ UL 94V-0 materials. \$2.30 (5000) for a 25-position connector.

**Viking Connectors Co, Box 2379, Chatsworth, CA 91311. Phone (818) 341-4330.**

Circle No 597

## DIN CONNECTORS

Types B and C 2-piece DIN 41612 connectors offer economical pin and socket pc-board connections. They provide high contact density and eliminate the potential problems associated with board warping or variations in thickness. Both connectors are available in 0.1- and 0.2-in. contact-spacing arrangements. Type B can have as many as 64 contacts; Type C has a 96-contact capability. Both types meet MIL, DIN, and IEC specifications.

The hard-gold-plated contact tails are available in a number of versions—straight pc pin, right-angle pc, wire wrap, and solder lug. The standard connectors come with tuning-fork-style contacts. Bifurcated cantilever-style contacts, with lower insertion and withdrawal forces, are optional. Hardware options include coding pins and coding strips that ensure mating. Type B, \$1.62 (500).

**Vernitron Corp, Beau Products Div, Box 10, Laconia, NH 03247. Phone (603) 524-5101.**

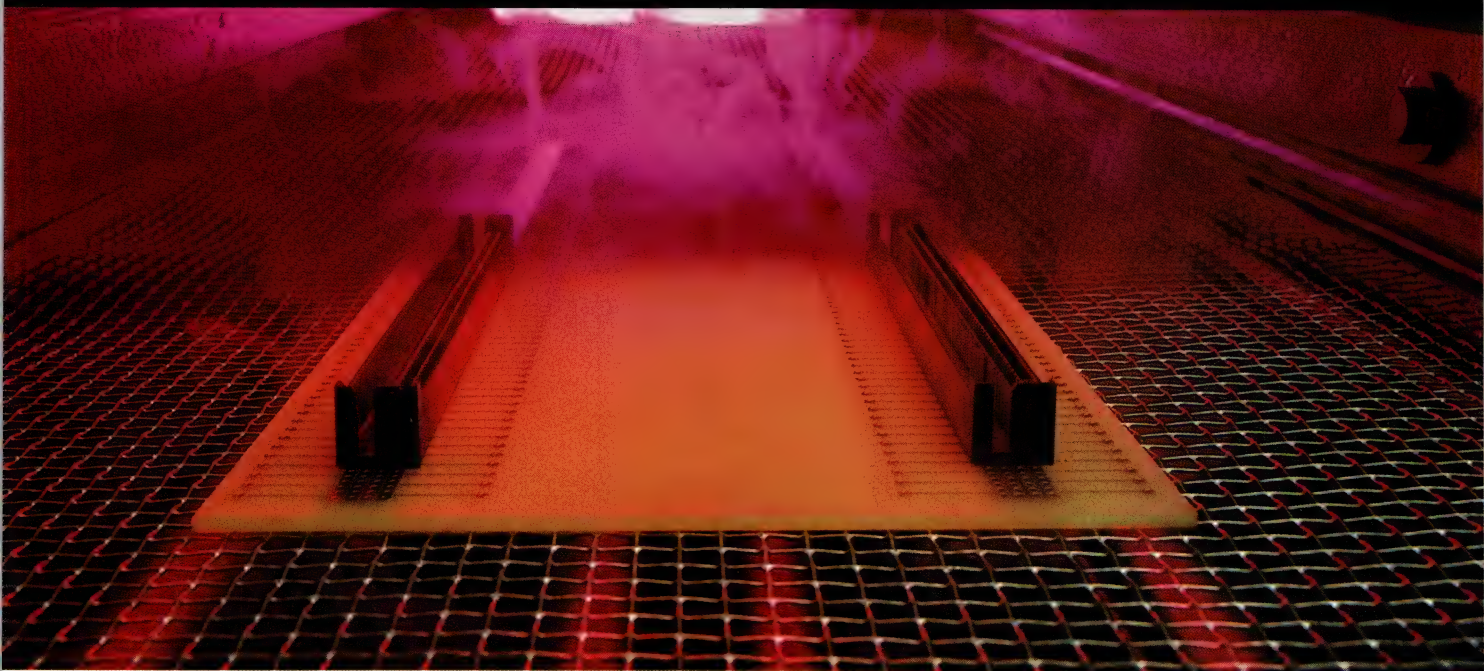
Circle No 600

## CONNECTOR SYSTEM

The compact Consyse connector system features only two insertion and withdrawal points between mother/daughter board and I/O connections. Measuring approximately 7 in. long, the connector system consists of a surface-mount socket and a pliant pin header that mates the daughter and mother boards. When stacked back to back, as many



# DuPont RYNITE® beats the heat of vapor phase and wave soldering



## RYNITE® thermoplastic polyester resin withstands 419°F in vapor reflow, 525°F in under-board wave soldering

Component manufacturers are capitalizing on the 435°F (224°C) heat deflection temperature of RYNITE® PET, a polyethylene terephthalate, to beat the heat of wave and vapor phase soldering. RYNITE also offers a UL temperature index of up to 155°C.

### DuPont Connector Systems

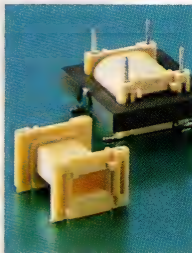


DuPont Connector Systems chose RYNITE over PPS for a new line of slotted header connectors that resist the 419°F of vapor phase soldering

and the 525°F of under-board wave soldering. DuPont Connector Systems selected RYNITE because it exhibits greater elongation and is less abrasive on the mold than PPS.

### Midtex bobbin

The Midtex Division of Midland-Ross uses RYNITE for Midcom modem transformer bobbins that maintain their shape even under the 525°F heat of under-board wave soldering.



Midtex chose RYNITE polyester for better molding performance and for cost savings.

### Ericsson connector

L.M. Ericsson replaced PBT poly-

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CIRCLE NO 87

## Hardware

as 20 I/O connectors plug directly into the header through an alignment shroud that's only 1.5 in. from the daughter-board connection.

The header and socket are arranged in a 4-row, 0.1-in. grid, providing a 256-position configuration, which can be designed to your specifications. The I/O connectors are available in 8-, 16-, 24-, 40-, and 56-position versions; preloaded connectors are also available. The terminals are insulation-displacement-contact types, and their tin plating provides EMI shielding. \$0.35 (500) per through-line, including header, socket, and I/O connector.

**Fujitsu Component of America, 3320 Scott Blvd, Santa Clara, CA 95054. Phone (408) 562-1000.**

Circle No 599



### F-O CONNECTOR

The 152-WEC-SFI biconic single-mode fiber-optic connector is designed for permanent installation in the field, not just emergency or temporary repairs. It can mate with the Dorrans and AT&T biconic connectors, and it's available in factory-installed and field-installable configurations.

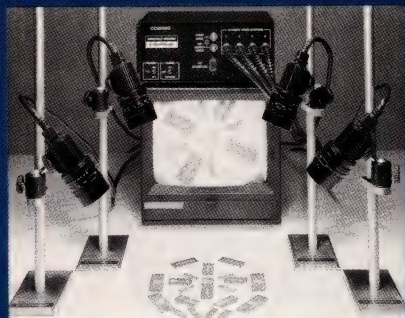
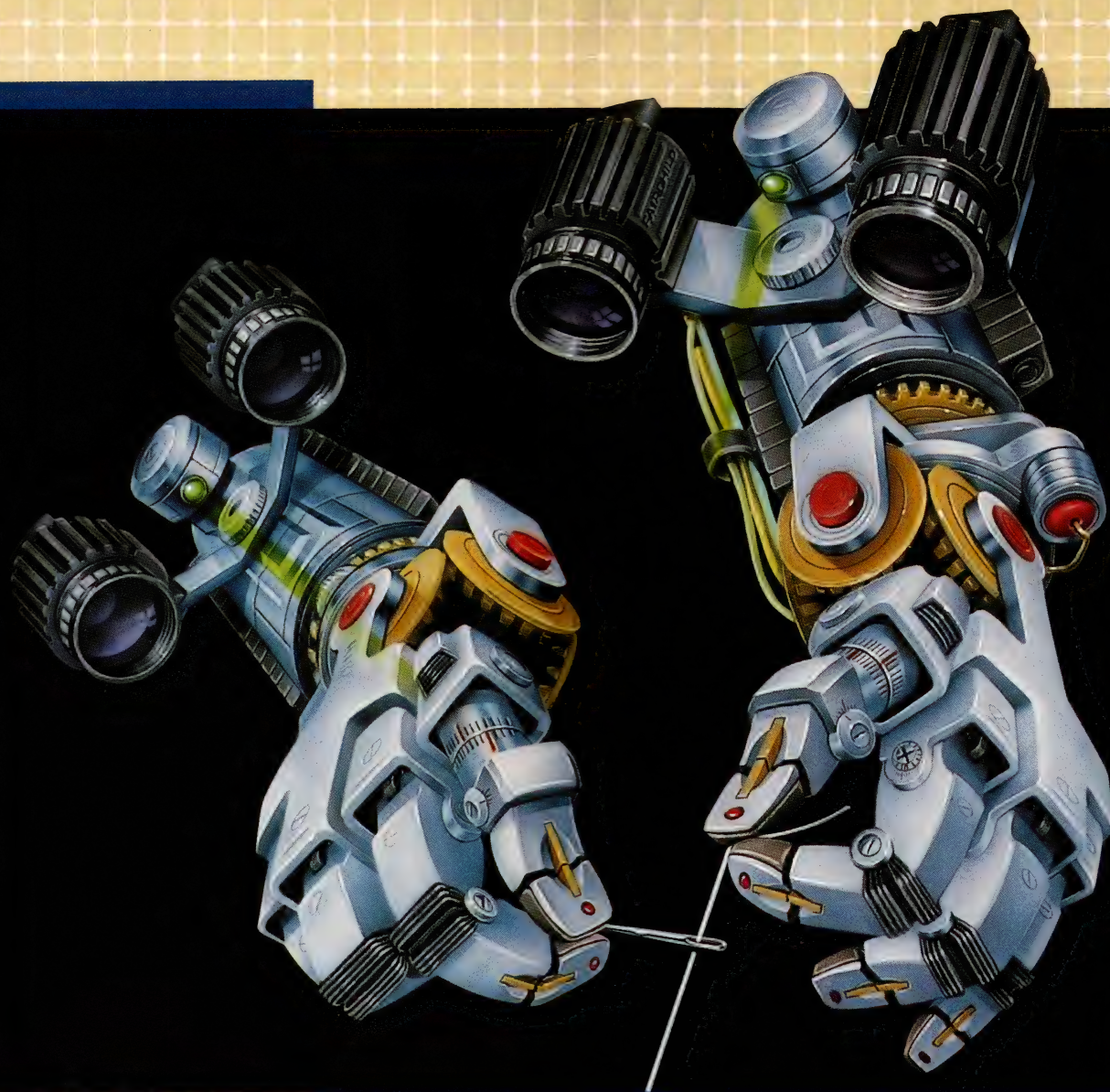
The connector has a splice loss of 1 dB max when it's used with 10/125-μm fiber. Its return losses of -28 to -32 dB demonstrate low reflectivity. The connector has a hard anodized aluminum body, a ceramic ferrule for high thermal stability, capillary corrosion resistance, and fiber protection at contact ends—the ceramic, which is harder than glass, bears the load of contact. \$49 (100).

**OFTI, Box 148, Nutting Lake, MA 01865. Phone (617) 663-6629. TLX 948288.**

Circle No 601



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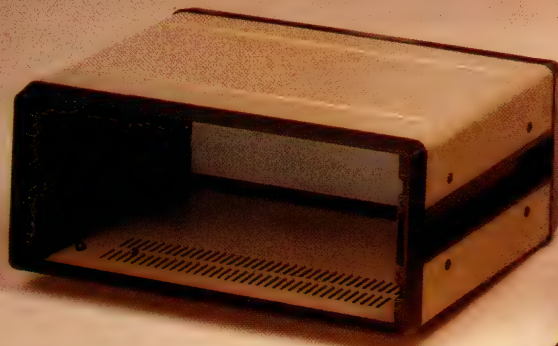
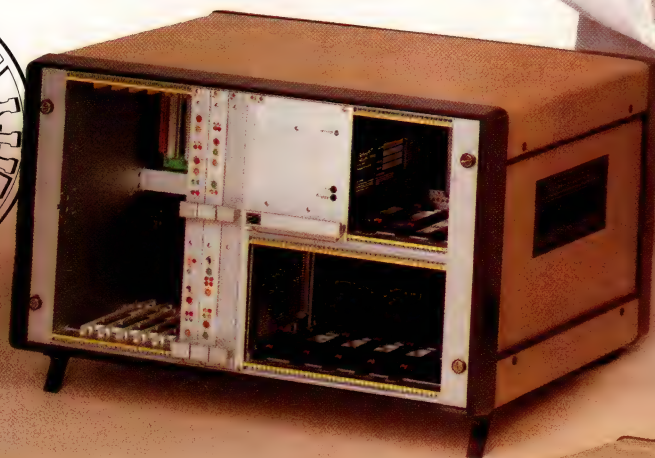
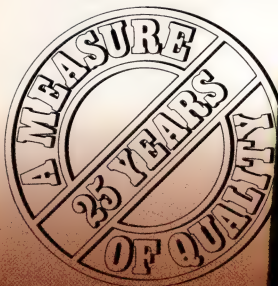
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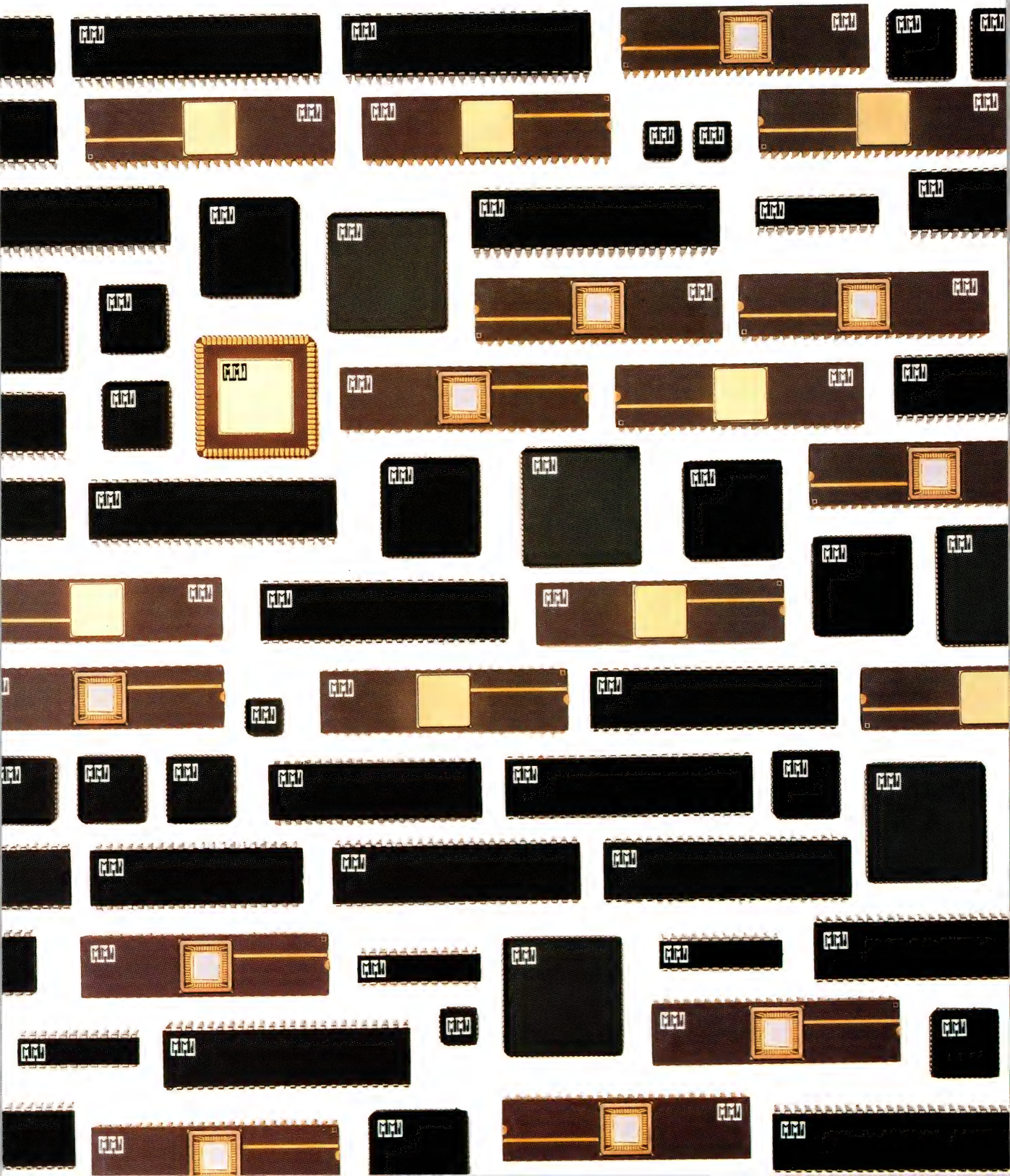


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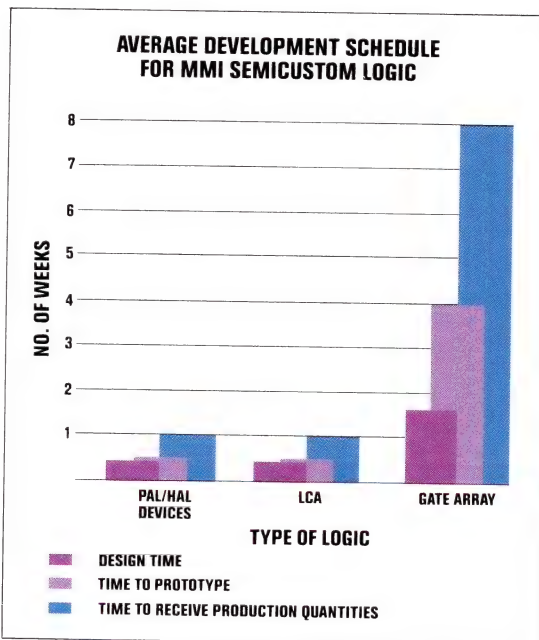
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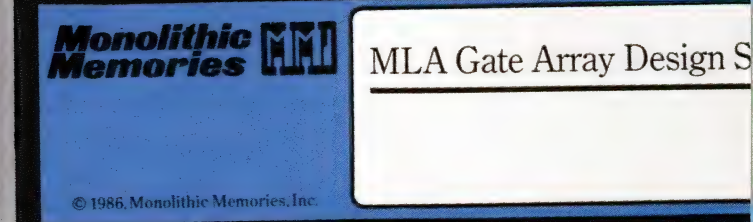
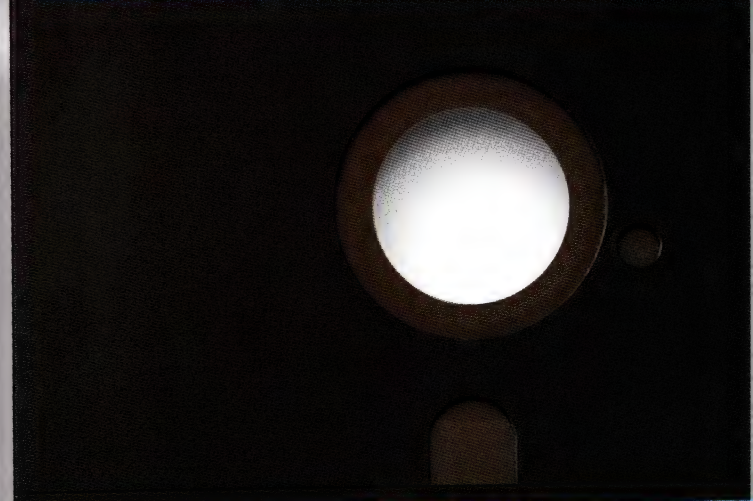
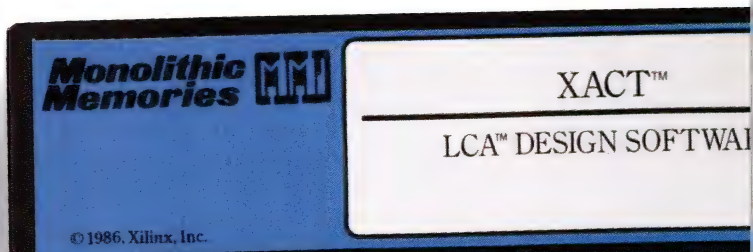
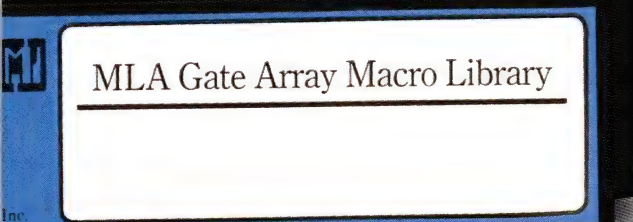
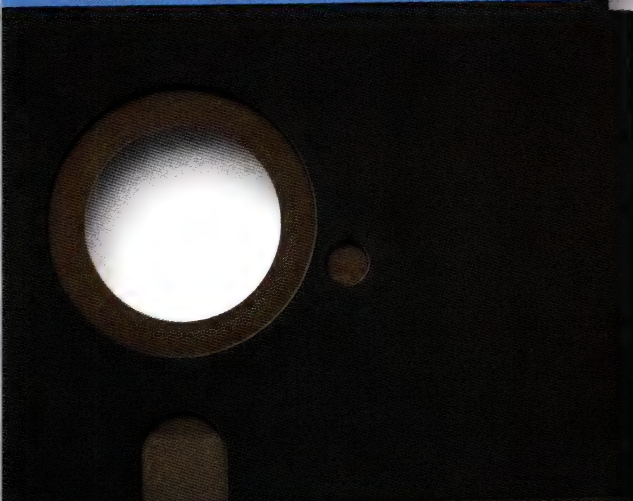
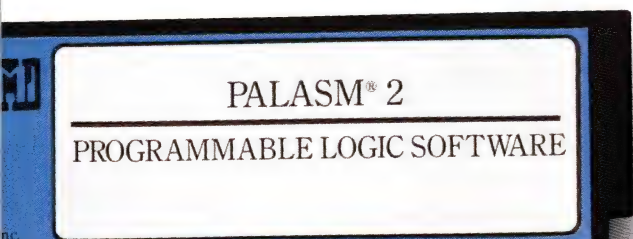
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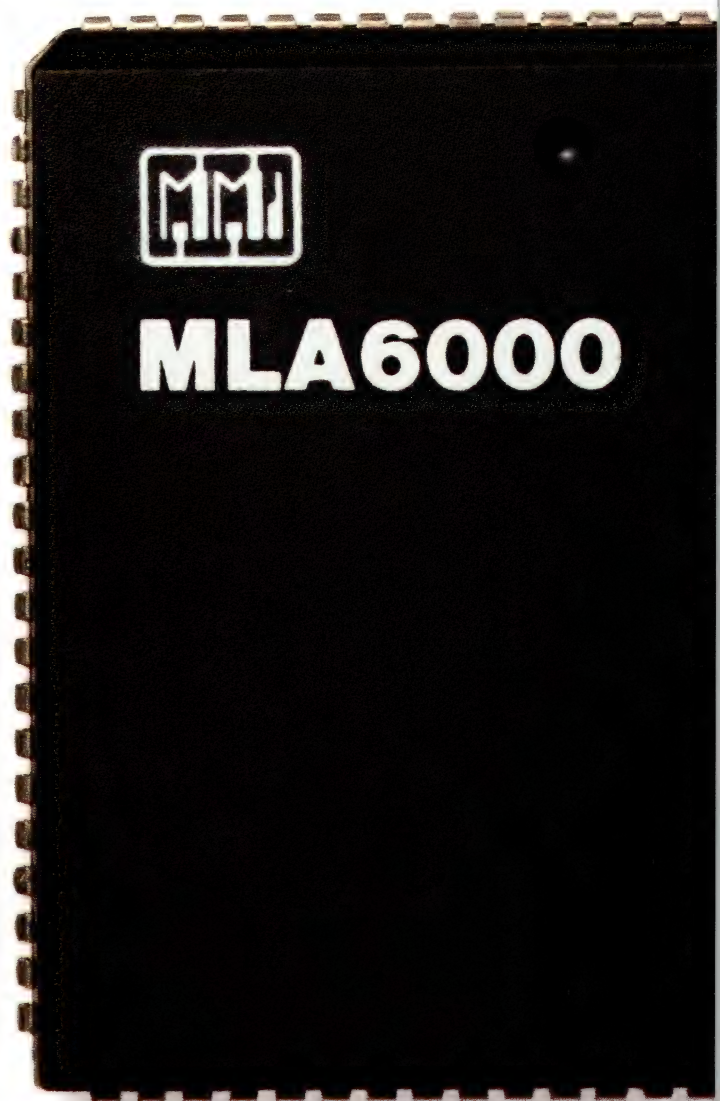
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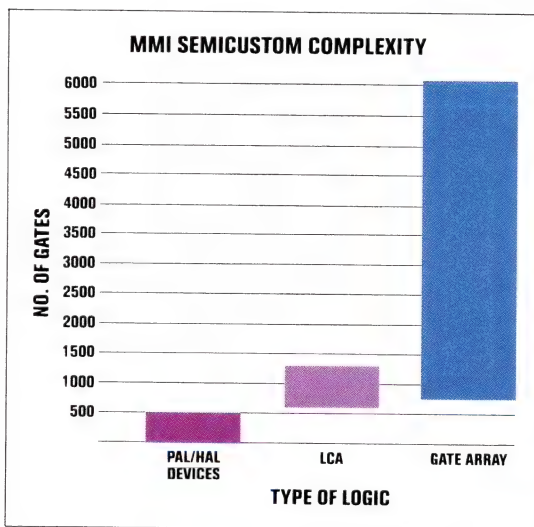
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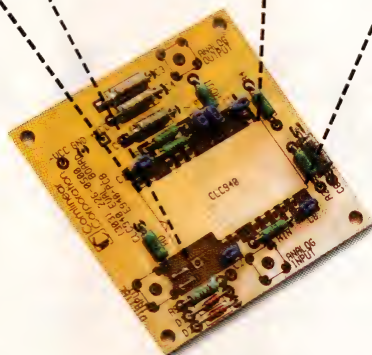
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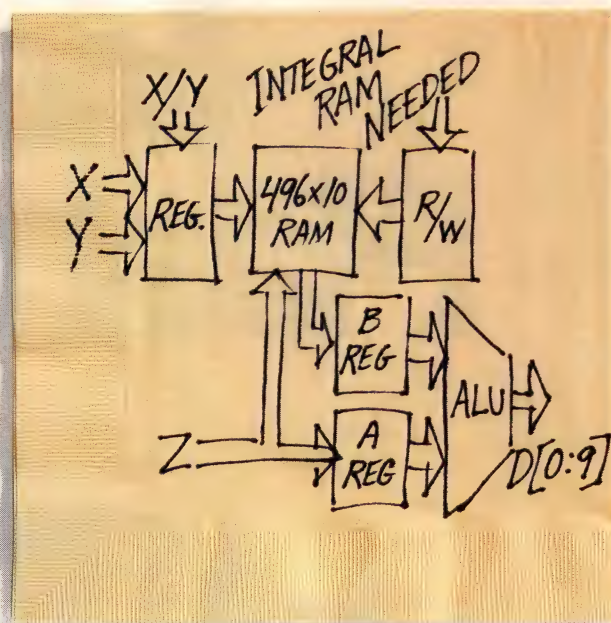
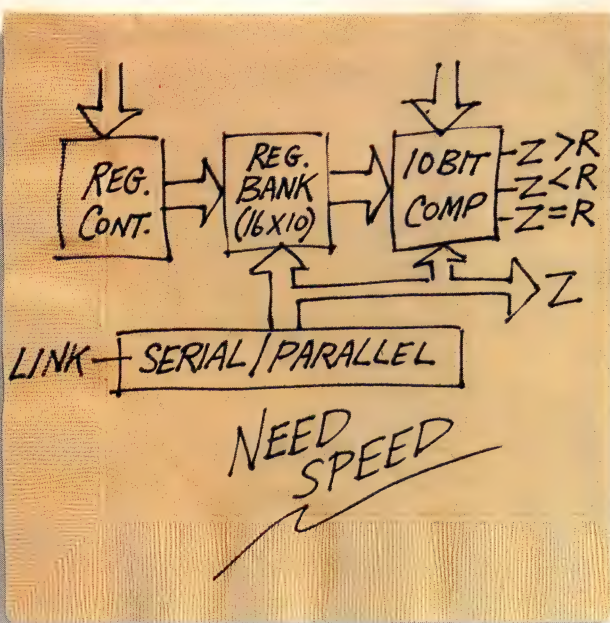
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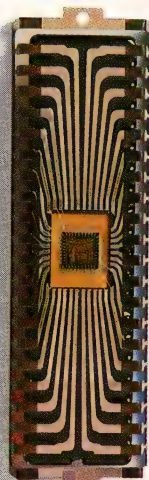
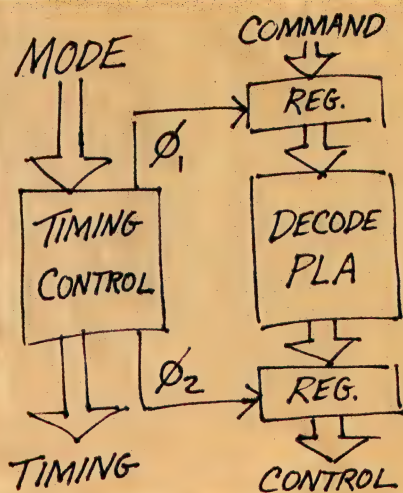
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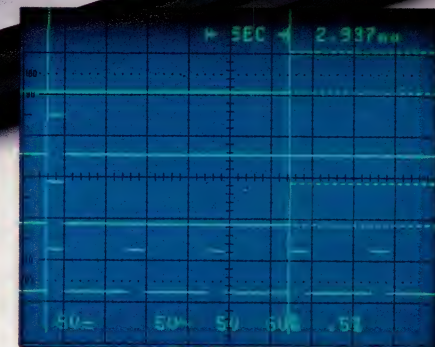
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The 2246 provides direct time readout information when seconds is selected in cursor mode. You also have 1/seconds in Hz and phase capability.



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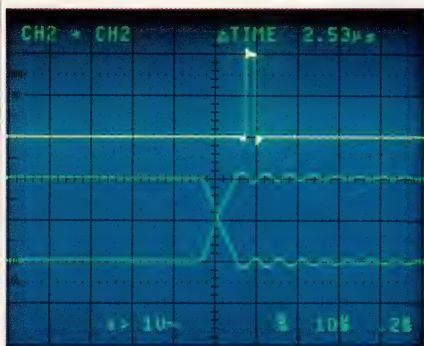
**On top: the 2246 with exclusive integrated push-button measurements.** Your measurements are accessed through easy, pop-up menus and implemented at the touch of a button. Measure  $\pm$  peak volts, peak-to-peak, dc volts and gated volts with new hands-off convenience and on-screen readout of values.

SmartCursors™ track voltmeter measurements in the 2246 and visually indicate where ground and trigger levels are located. Or use cursors in the manual mode for immediate, effortless measurement of waveform parameters like voltage, time, frequency, and phase.

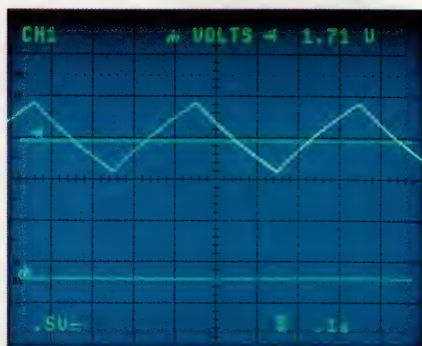
**Both scopes build on performance you haven't seen at the bandwidth or prices.** Lab grade features include sweep speeds to 2 ns/div. Vertical sensitivity of 2 mV/div at full bandwidth for low-level signal capture. Plus trigger sensitivity to 0.25 div at 50 MHz, to 0.5 div at 150 MHz.



Features	2246	2245
Bandwidth	100 MHz	100 MHz
No. of Channels	4	4
Scale Factor Readout	Yes	Yes
SmartCursors™	Yes	No
Volts Cursors	Yes	No
Time Cursors	Yes	No
Voltmeter	Yes	No
Vertical Sensitivity	2 mV/div	2 mV/div
Max. Sweep Speed	2 ns/div	2 ns/div
Accuracy: Vert/Hor	2%/2%	2%/2%
Trigger Modes	Auto Level, Auto, Norm, TV Field, TV Line, Single Sweep	
Trigger Level Readout	Yes	No
Weight	16.5 lb/7.5 kg	16.5 lb/7.5 kg
Warranty	3-year on parts and labor including the CRT	
Price	\$2400	\$1875



Conventional  $\Delta$ Time measurement is also available from the menu in the 2246 for increased timing accuracy. Shown above: a  $\Delta$ Time measurement of pulse width.



The 2246 also makes it possible to measure either  $\Delta$ Volts or absolute volts from ground.

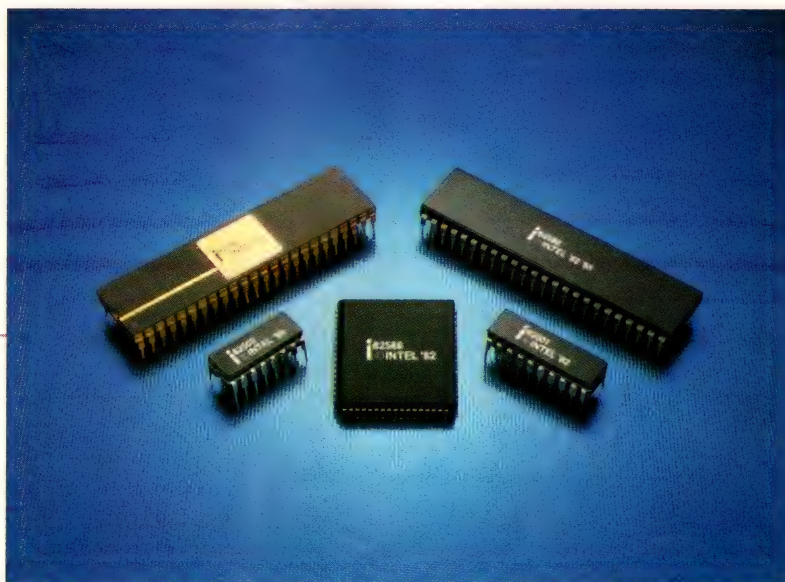
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# LAN ICs let you build networks for PCs

*VLSI technology has finally reduced chip costs enough to help you build reasonably priced LAN-node cards for insertion in personal-computer-based workstations. Yet chip makers and designers of these boards alike are still debating over which LAN standards provide the most cost-effective way to implement your PC network.*



*Ethernet/Cheapernet LAN coprocessor and interface chips (Intel Corp)*

Denny Cormier, *Regional Editor*

Users who wish to tie their personal-computer-based workstations into a local-area network (LAN) have myriad LAN protocols to choose from, but actual chip- and board-level products are only available for the IEEE-802 protocols and a few proprietary LANs—for example, Corvus's Omninet. NEC has recently built a LAN-node chip set around the Omninet protocols, which engineers outside the US—Europe and Japan

especially—continue to favor. In the US, IEEE-802 standards for LANs are becoming increasingly popular (see **Refs 1** through **3**), and Advanced Micro Devices, Intel, National Semiconductor, Seeq Technology, and Texas Instruments have created their own families of ICs for LAN-node cards.

LAN ICs help you build boards that fit in the backplane of your PC and do the work of the network



node—that is, establish the connection between your PC and the network. This connection plays a big role in ensuring that your PC can communicate with other resources and that your network can expand to meet future needs. Indeed, the increasing acceptance of standards of any kind stems from users' demand that some common scheme govern network design. LANs ideally serve the purpose of group communication with a shared database. It's therefore logical that a standard "language" would not only be useful, but would indeed be an essential part of LAN firmware, allowing LAN-node cards made with chips from different companies to "talk" to one another in a kind of computer Esperanto.

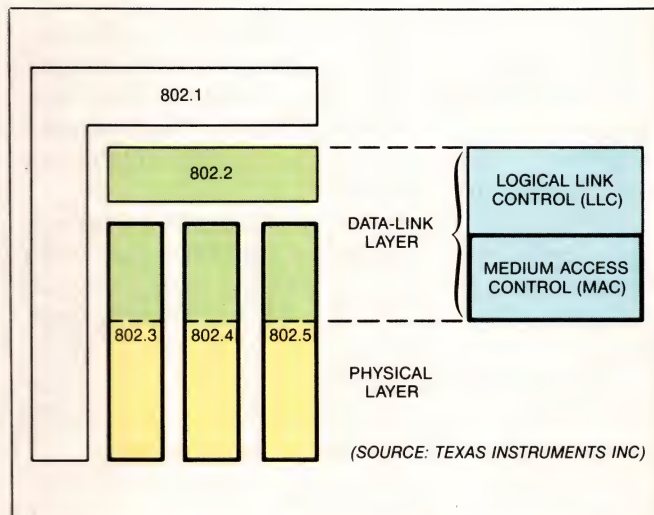
Until quite recently, however, numerous proprietary networks created a veritable Tower of Babel situation for designers wanting to connect LAN nodes produced by different manufacturers. In an effort to remedy this computer-protocol barrier, the International Standards Organization (ISO) has proposed an elaborate computer-network scheme in the form of an ambitious set of standards known as the Open Systems Interconnection (OSI) model.

### Translating IEEE-802 datacomm standards

The IEEE's 802 subcommittee has attempted to define practical hardware standards for implementing the physical (hardware) and data-link (firmware) layers of the 7-layer OSI model (Ref 4). The IEEE-802 subcommittee found that, even with existing VLSI technology, a single universal LAN node, capable of handling the full range of connection topologies and data-transfer rates, would simply be too expensive for the majority of users. The subcommittee therefore divided the hardware, or Medium Access Control (MAC), portion of the 802 standard (Fig 1)—the portion required to interface the data-link and physical layers—into three compromise LAN-topology standards:

- A bus/star topology using a Carrier Sense Multiple Access/Collision Detect (CSMA/CD) access method (standard 802.3)
- A bus topology using a token-passing access method (standard 802.4)
- A ring topology using a token-passing access method (standard 802.5).

In addition, the IEEE-802 subcommittee defined standards for Logical Link Control (LLC) within the data layer (802.2) and a set of network-management standards (802.1) for the same layer. At present, no available chips specifically handle 802.4 LANs. Chip



**Fig 1—IEEE-802 standards let you select three basic hardware configurations to interface the OSI data-link layer with the physical layer. Right now, however, you can only get dedicated ICs to handle PC-LAN nodes conforming to 802.3 and 802.5 protocols.**

manufacturers and users plan to adapt this standard to factory-automation applications.

Table 1 gives a breakdown of the IEEE-802 LAN standards with respect to applications, bit rates, comparative costs, and representative vendors of node equipment. Note that the 802.3 standard divides further into Ethernet (10BASE5), Cheapernet (10BASE2; it uses less expensive cables and transceivers than Ethernet), and StarLAN (1BASE5).

This hierarchy of standards means that you have to think in terms of top-down development, especially at the chip level of your LAN design. In other words, the logical way to choose a LAN-node design is to determine whether you want to conform to the OSI model and then make successive decisions about configuration, access method, data-transfer rate, cost, and, finally, features of specific products.

### One chip set for 802.5 networks

Only Texas Instruments has attempted to implement the complex 802.5 token-ring protocols. Its 4M-bps TMS380 5-chip set, which costs \$150 (100), comprises the 38010 communications processor, the 38020 protocol handler, the 38030 system interface, the 38051 ring-interface transceiver, and the 38052 ring-interface controller. The company jointly developed these ICs with IBM.

To support engineers who want to design a LAN-node card with the TMS380 chip set, TI offers a range of development tools, including a PC/XT/AT adapter



*Until quite recently, numerous proprietary networks have created a veritable Tower of Babel situation.*

card (\$1750), development software (\$875), and a test-wiring concentrator (\$1990). These tools let you build prototype hardware and develop and debug upper-level software for your token-ring PC node. The going market price for completed token-ring PC/XT/AT-node cards is approximately \$700.

Boards of this type are now available and are instructive examples of how to use the TMS380 set and other chip sets. One such board, IBM's token-ring LAN-node card, incorporates the TMS380 chips and sells for \$695. This price is comparable to the cost of today's intelligent Ethernet/CheaperNet PC-LAN nodes, such as the \$795 Exos-205 card from Excelan, which uses an 8-MHz Intel 80186  $\mu$ P and an 82586 LAN coprocessor.

#### IBM supports token-ring LANs

According to TI's LAN product manager, Rich Templeton, OEM LAN designers will find an 802.5-type network attractive because it provides IBM compatibility, works with twisted-pair PBX phone lines, and transfers data at 4M bps (Fig 2). One drawback is that

the twisted-pair cabling for connecting 802.5 token-ring networks must be shielded, which would involve installing shielded cable. StarLAN 802.3/1BASE5 LAN standards employ in-place, unshielded twisted-pair (24-gauge) phone lines, but data-transfer rates for this network are limited to 1M bps.

Templeton sees the 802.5 token-ring topology as providing the basis of a new generation of low-cost, diskless, 16- and 32-bit workstations with PC-LAN nodes built into the backplane. These workstations would have file servers that call files and programs from other resources in the network. The inherent versatility of the 802.5 specs at the chip level, with such features as functional addressing and regular network access, not only simplifies token-ring LAN-node design but also simplifies the task of building bridges to other types of LANs and to fiber-optic networks, such as the Fiber Distributed Data Interface (FDDI) network.

AT&T has been actively promoting and participating in the development of the StarLAN standards with Intel and about 30 other telecomm companies, for the

**TABLE 1—FEATURES OF THE IEEE-802 LAN STANDARDS**

	ETHERNET	CHEAPERNET	STARLAN	TOKEN-PASSING RING	TOKEN-PASSING BUS
APPLICATION	BACKBONE, CAD/CAE	CAD/CAE	OFFICE LAN	OFFICE LAN	FACTORY LAN
BIT RATE	10M BPS	10M BPS	1M BPS	4M BPS	10M BPS
COMPARATIVE HARDWARE COST PER NODE*	1.0	0.6	0.3	0.7	3.0
SUPPORTING LAN-NODE COMPANIES (PARTIAL LISTING)	INTEL XEROX DEC INTERNATIONAL COMPUTERS LTD HP 3COM UNGERMANN-BASS INTERLAN BRIDGE COMMUNICATIONS BURROUGHS NCR DATA GENERAL TEXAS INSTRUMENTS OLIVETTI	INTEL XEROX DEC INTERNATIONAL COMPUTERS LTD HP 3COM	INTEL AT&T/IS XEROX HP BURROUGHS NCR DATA GENERAL TANDEM WANG OLIVETTI CII BULL FOX RESEARCH WESTERN DIGITAL TEXAS INSTRUMENTS INTERLAN EXCELAN	IBM TEXAS INSTRUMENTS UNGERMANN-BASS SYTEK 3COM BRIDGE COMMUNICATIONS EXCELAN NESTAR	INTEL GM HP IBM DEC INDUSTRIAL NETWORKING CONCORD DATA ALLEN BRADLEY DATA GENERAL CINCINNATI MILACRON
STANDARD	IEEE 802.3 10BASE5	IEEE 802.3 10BASE2	IEEE 802.3 1BASE5	IEEE 802.5	IEEE 802.4

\*RELATIVE TO ETHERNET NODE

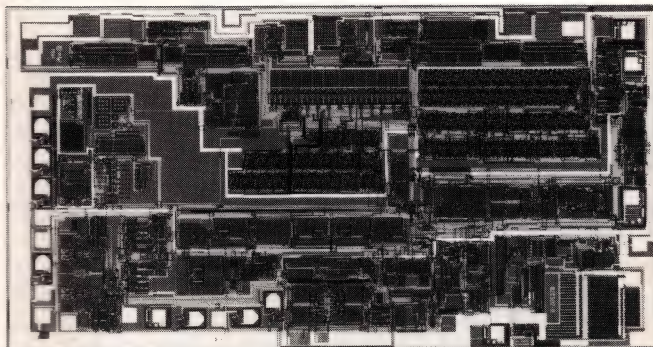
(SOURCE: INTEL CORP)



obvious reason that StarLAN systems use the twisted pairs and RJ11 phone jacks already in place in conventional PBX wiring closets. Yet most industry experts maintain that StarLAN and token-passing ring networks will occupy different applications niches and can coexist peacefully.

One such person is Bob Galin, Intel's LAN product manager and chairman of the IEEE StarLAN subcommittee. He believes that StarLAN and token-passing ring networks will be the two most prevalent LAN topologies for PC workstations. He concedes that, if your PCs use peripherals that require a high degree of compatibility with an IBM bus architecture, a token-passing ring network is the best choice, provided you are willing to pay the extra cost to realize IBM compatibility and a high data-transfer rate in hardware. On behalf of StarLAN, however, Galin adds that 1BASE5 LANs have some distinct advantages over the 802.5 specs. For one thing, StarLAN nodes offer the Multi-Point Extension (MPE) option, which allows a high degree of downstream branching.

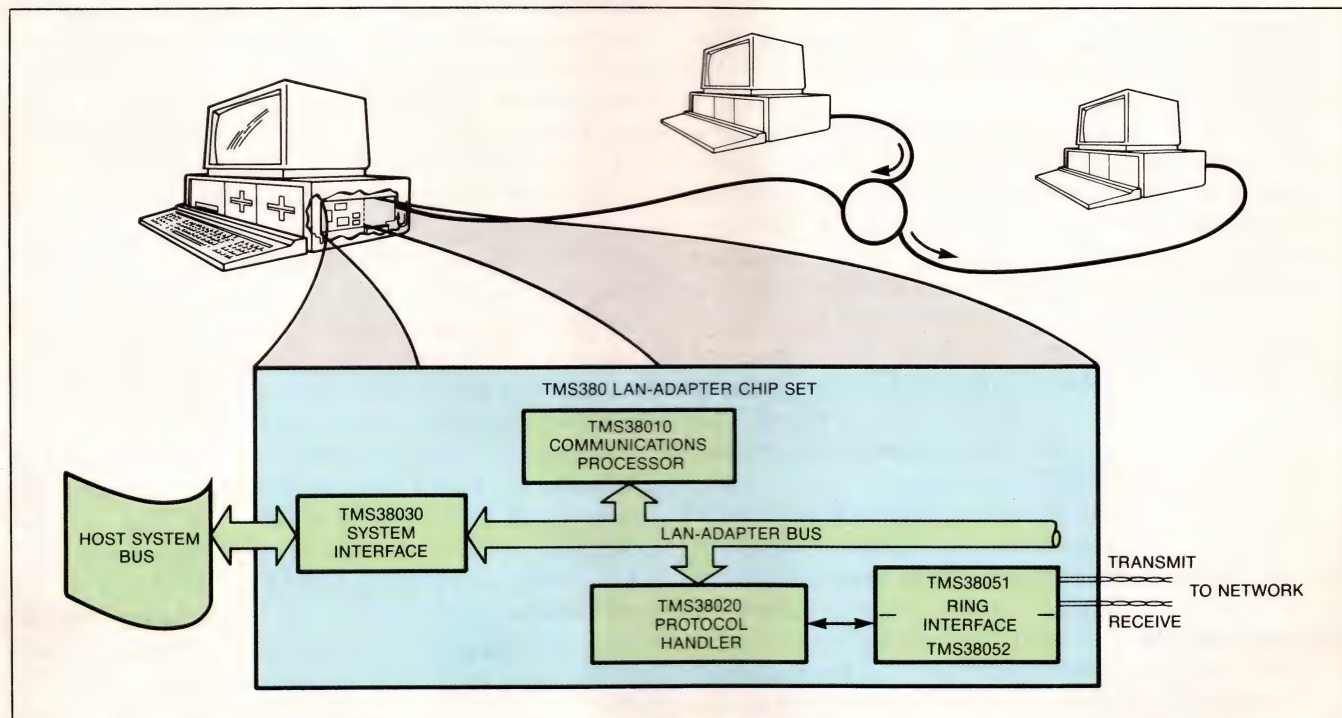
Perhaps the most attractive feature of StarLAN is that it has potentially the lowest cost per node of all IEEE-802 LAN configurations. Projected costs for



*Ethernet/CheaperNet transceiver IC (Intel Corp)*

nonintelligent StarLAN boards in 1987 are estimated at \$300 in single quantities, and for less than \$200 in OEM quantities. Within two years, these costs could easily drop by almost 50%, or to about \$150 retail.

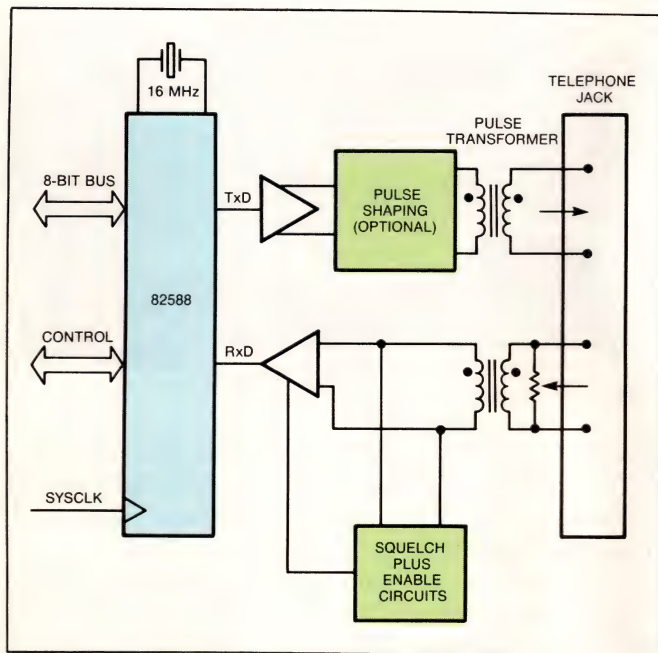
But StarLAN standards are not quite final. And chip makers are understandably reluctant to plunge ahead into this relatively unfamiliar ground. Galin cautions that the IEEE StarLAN subcommittee has a few more steps to complete before the 802.3/1BASE5 revisions (Draft G), including accommodations to "fold in" MPE options, are final. Fortunately, rapid approval by the



**Fig 2—You can design an entire 802.5 token-passing ring LAN that connects to PC/XT/AT nodes over twisted-pair links by using Texas Instruments' TMS380 LAN-adapter chip set. All 802.5 protocols for 4M-bps data transfers are stored as firmware in the TMS38020 protocol-handler IC.**



*The logical way to choose a LAN-node design is to think in terms of top-down development, especially at the chip level of your LAN design.*



**Fig 3—The network management necessary to operate a 1M-bps StarLAN PC node** is available in a combination of Intel's 82588 LAN controller IC and an 8-bit  $\mu$ P. StarLAN (IEEE-802.3/1BASE5) is the newest member of the 802.3 LAN standards. You can set up a StarLAN using the in-place twisted-pair wiring of your PBX.

ISO/OSI board of governors is expected early next year, along with acceptance of an ANSI version of the same standard.

StarLAN in its simplest form is almost ideal for a small LAN cluster—say, four PCs and a laser printer connected to a database. Indeed, StarLAN provides the least expensive way to achieve such a cluster with an industry-standard LAN. More significant is the fact that you'll be able buy a laser printer from one vendor and a PC workstation from another and then daisy-chain the rest of your network with the MPE options as the need arises. In other words, you can start a simple StarLAN system with a radial topology in your PBX's wiring closet, and you can later expand your network with the bus-oriented MPE options.

Like its 802.3 cousin Ethernet, StarLAN only specifies hardware and protocols for the bottom 1½ layers of the ISO standard. Both are essentially implementations based upon the CSMA/CD active protocols—active in the sense that the CSMA/CD medium-access method is one that constantly interrogates the bus for availability. Because Ethernet and StarLAN are medium-access protocols, they are transparent to any particular high-level OSI protocols.

It's worth noting that Ethernet, Cheapernet, and

StarLAN all conform to the Transmission Control Protocol/Internet Protocol (TCP/IP), developed by the Department of Defense over the past four to five years. TCP/IP is similar to the OSI model at layers 3 and 4 (Ref 5), so going with a TCP/IP-based network shouldn't hinder your eventual migration to a full OSI system, once the full set of standards is fixed. One current version of TCP/IP is an extension of PC-DOS called NetBios/API (Application Program Interface).

### StarLAN wars: Competing chip sets

As you may have suspected, Intel recommends its 8-bit, 28-pin 82588 as the ideal LAN controller IC for your PC StarLAN node designs (Fig 3), and the company has even gone to the trouble of offering a StarLAN-node demonstration board built around this chip to prove the point. A handy feature of the 82588 is its on-chip Manchester encoder/decoder, which means you won't need a serial-interface IC like the company's 82501. You can obtain the 82588 in a ceramic DIP for \$31.75 or in a PLCC for \$34.25 (100).

Chips and Technologies offers a CMOS front-end chip set comprising the 82C550 serial-interface and 82C551 hub-controller ICs. These chips work with Intel's 82586 LAN coprocessor and RS-422 or -485 transceivers to accommodate MPE options. An on-chip antijabber function lets you cascade as many as five 82C551 controller ICs to support a daisy-chained, 40-node StarLAN system. The company sells the 20-pin -550 and the 40-pin -551 in plastic DIPs for \$15.60 and \$56.70 (100).

Last August Exar Corp announced that it too will begin producing, in the first quarter of 1987, a StarLAN chip set including the bipolar XR-T82515 transceiver and the CMOS XR-T82C516 controller, as part of a joint agreement with an NCR division (Utrecht, The Netherlands). Samples of both devices are available now, and estimated pricing for the chip set when full production starts is \$15 to \$20 (1000).

Cheapernet and Ethernet are well established as LANs for PC-based workstations; approximately 300 vendors sell Ethernet products. For that matter, Ethernet/Cheapernet LANs are preferable to StarLAN when you're using the latest IBM PC/AT/RT workstations operating at 8 MHz or higher. For instance, a Cheapernet PC-LAN node is almost a perfect fit when you need 10M-bps data-transfer rates for high-end workstations, whereas StarLAN is best suited to a general-purpose (5 MHz, 1M bps) PC environment.

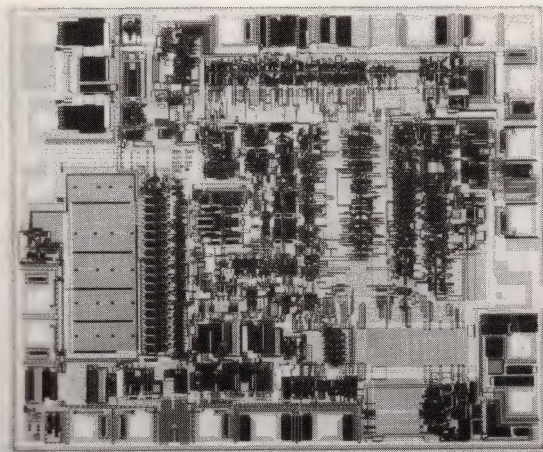
Ethernet/Cheapernet chips are available from a num-



ber of sources. AMD, Intel, and National Semiconductor supply their Ethernet/Cheaperpet LAN-node ICs in the form of 3-chip sets comprising a LAN controller/coprocessor, a Manchester encoder/decoder, and an interface transceiver. Keep in mind that you'll need to link the controller/coprocessor ICs to a 16-bit  $\mu$ P, such as an 8086, a 68000, or a Z8000, to provide enough processing power to handle 802.3 software protocols in high-end, 10-MHz PCs.

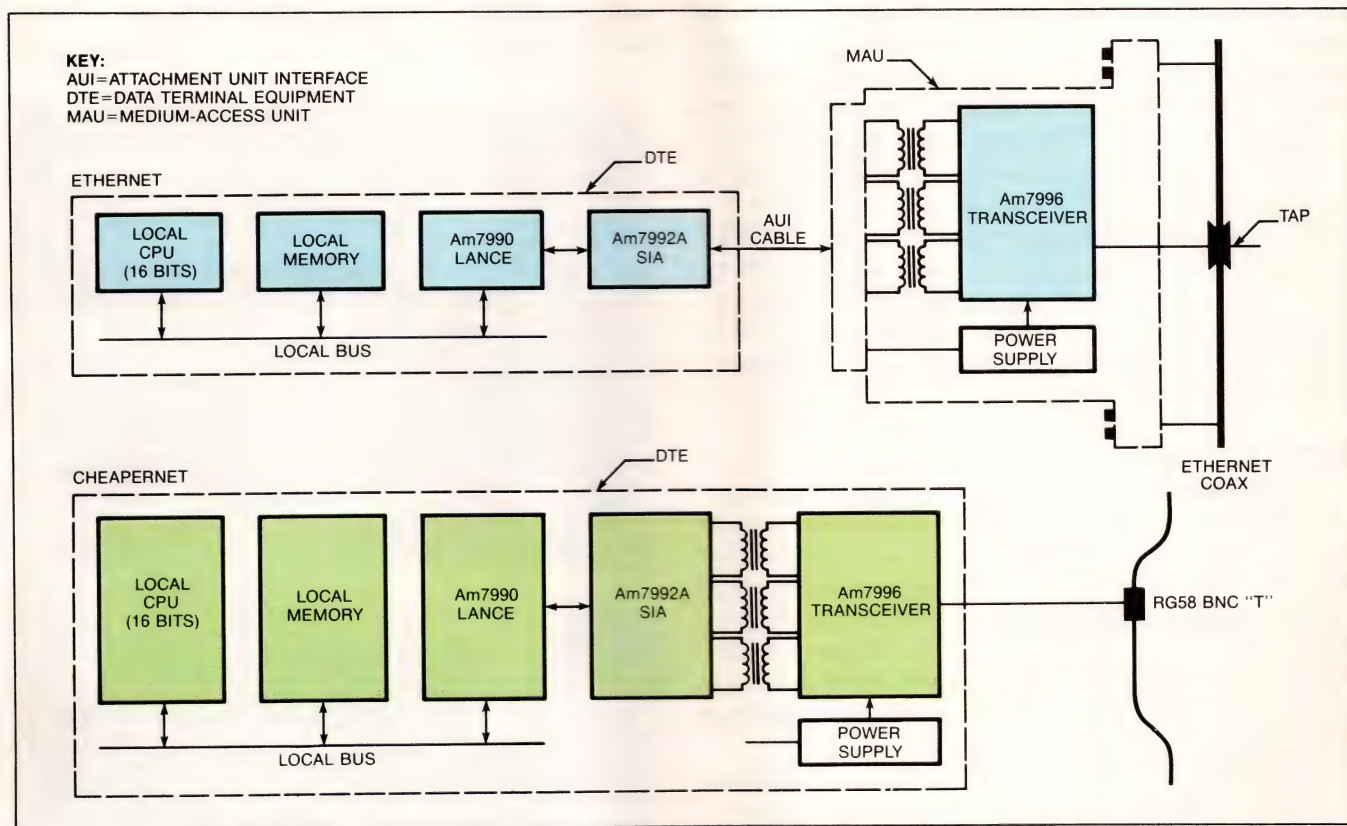
AMD lauds the virtues of bipolar technology in the fabrication of Ethernet/Cheaperpet IEEE-802.3 chips, exemplified by its Lance IC family (local-area-network controller for Ethernet; see Refs 6 and 7). Steve Dines, the company's LAN applications director, states that bipolar technology is better suited to LAN ICs than CMOS, especially at the interface level, because bipolar ICs can better handle the transient overloads created by bus contention.

Fabricated with its proprietary IMOX bipolar technology, AMD's 3-chip Ethernet/Cheaperpet LAN-node set consists of the Am7990 Lance, the Am7992A SIA (a



Manchester encoder/decoder chip (Seeq Technology Inc)

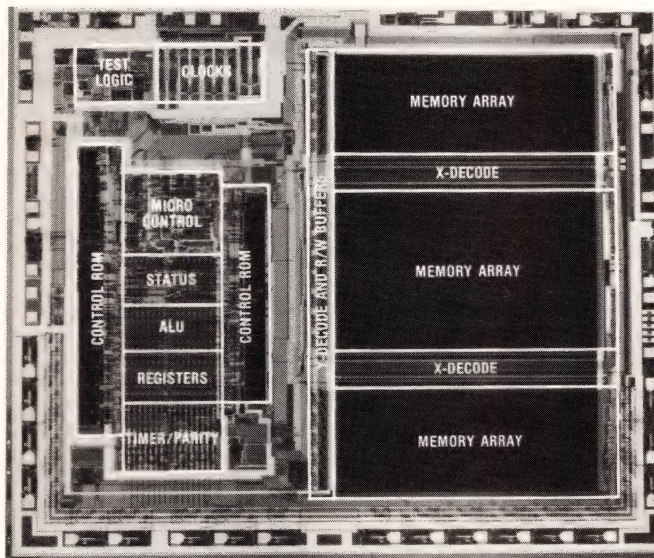
Manchester encoder/decoder), and the Am7996 transceiver (Fig 4). Not only can you tie the Lance directly to a 16-bit data bus, but the device also handles DMA control for 802.3 LAN protocols. The Lance sells



**Fig 4—Whether you're designing a LAN node to the specifications of Ethernet or to those of its less expensive cousin Cheaperpet, you can meet or exceed either of these 802.3 CMA/CD specs with the Lance family of LAN ICs from Advanced Micro Devices. In the US, Ethernet and Cheaperpet are still the most popular implementations of PC LANs using the 802.3 standards.**



*The inherent versatility of the 802.5 specs at the chip level simplifies token-ring LAN-node design and the task of building bridges to other types of LANs.*



**Token-ring communications processor chip** (Texas Instruments Inc)

for \$54.95, the SIA for \$19.15, and the transceiver for \$23.90 (100). Thomson Components-Mostek is a second source for these devices. You can also purchase the company's \$900 Ethernet/CheaperNet node-evaluation board, the PCENEBD, to test the Lance chip set or to implement high-level datacomm software in your PC.

National Semiconductor uses bipolar technology to make its 24-pin DP8391N serial network interface (a Manchester encoder/decoder) and its 16-pin DP8392N coaxial-interface transceiver ICs. This month, however, the company introduced its 48-pin, CMOS Ethernet/CheaperNet DP8390N LAN interface controller chip, which is functionally similar to the Lance. The complete 3-chip set costs \$85 (100).

### Banking on CMOS

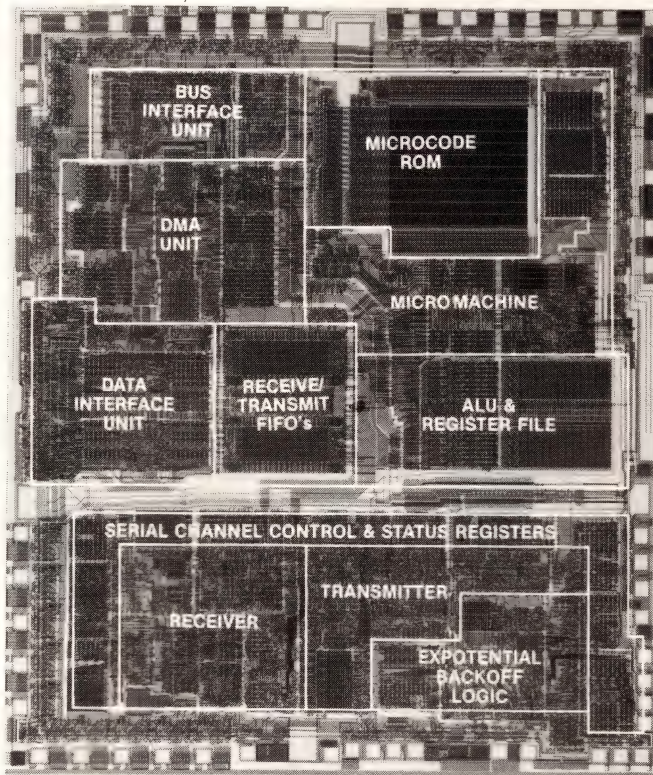
Intel makes a 3-chip Ethernet/CheaperNet set consisting of the 16-bit 82586 LAN controller/coprocessor IC, the 82501 serial interface (a Manchester encoder/decoder), and the 82C502 CMOS transceiver. The -586 and the -501 are fabricated in NMOS. You can buy the 82586 in a 48-pin plastic DIP for \$47, in a ceramic DIP for \$50, or in a PLCC for \$48.50 (1000). Both the 20-pin 82501 and 16-pin 82502 come in ceramic DIPs and cost \$27 (1000).

Despite allegations that CMOS is an unreliable process for 802.3 chips, Intel plans to fabricate all three of its Ethernet/CheaperNet ICs in CMOS by the end of next year. The company expects to introduce its CMOS 82C501 Manchester encoder/decoder in the first quar-

ter of 1987. Apparently Harris Semiconductor Corp and Seeq Technology agree with Intel, because they too are making CMOS 802.3 ICs. Seeq's CMOS 40-pin 8003 Ethernet LAN controller chip is functionally similar to the 82586; the company also makes the 8023 Manchester encoder/decoder in CMOS. The 8003 costs \$48.85, the 8023 \$44.45 (100).

Harris sells its CMOS, 24-pin HD-15530-8 Manchester encoder/decoder (MIL-STD-1553, approved by the Defense Electronics Supply Center) for \$128.04, as well as a 40-pin MIL-STD-883 version, the 2.5M-bps HD-15531B-883, for \$237.46 (100). The company also supplies a 20-pin, industrial-grade, CMOS Manchester encoder/decoder, the HD-6409-9, for \$9.43 (100).

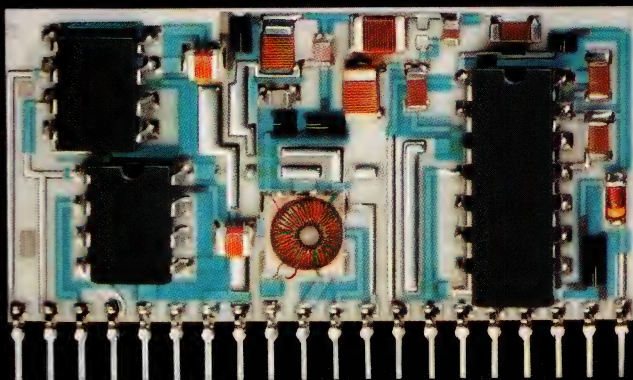
Now that the IEEE-802 standards are more mature, designers are asking if it makes any sense to use a proprietary LAN such as Corvus's Omninet or Data-point's (San Antonio, TX) ARCnet. As noted, proprietary LANs raise a real concern about a lack of hardware and software compatibility. On the other hand, many engineers question whether the IEEE-802 standard really constitutes a standard at all. After all, the fact that CheaperNet, Ethernet, StarLAN, and token-ring



**IEEE-802.3 LAN coprocessor chip** (Intel Corp)



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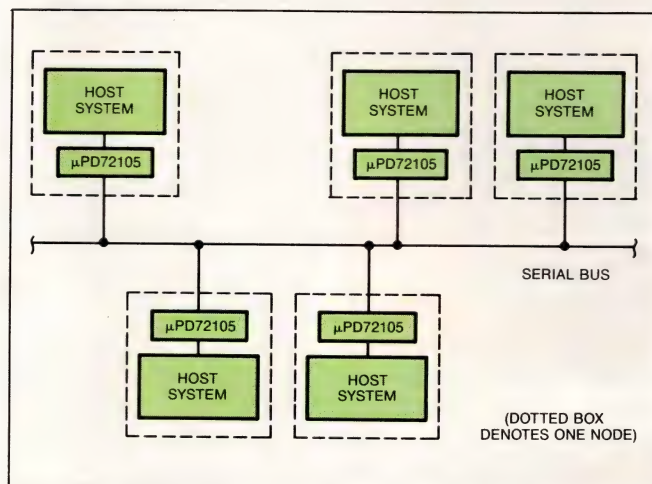
*StarLAN standards are not quite final, and chip makers are understandably reluctant to plunge ahead into this relatively unfamiliar ground.*

LANs all represent distinctly different hardware specs, and yet coexist within the same so-called 802 standard, suggests a contradiction in terms.

For this reason, and until such time as one of the IEEE-802 incarnations proves dominant, many foreign design engineers are understandably reluctant to abandon what they consider to be de facto LAN standards. By sheer force of numbers, Omninet leads the de facto standards race, claiming more than 30,000 LAN nodes in networks worldwide. Another proprietary LAN, ARCnet, has been available since 1977 and ranks as a strong contender for de facto imprimatur with almost 10,000 LAN nodes, including nodes in networks from Nestar, Tandy, and 3M.

Responding to the demand from foreign LAN users, NEC this year introduced a single-chip CMOS LAN controller IC for Omninet, the  $\mu$ PD72005, and has another one, the  $\mu$ PD72105, scheduled for introduction in the first quarter of 1987. Both cost approximately \$25 (1000). Both chips support 4M-bps CSMA Omninet-II LAN nodes, which can be linked in a bus topology over shielded twisted-pair lines using RJ11 phone jacks (Fig 5). And even though Omninet-II is a proprietary network, the ICs implement the first two OSI layers and portions of layers 3 and 4 (see Ref 8).

Although it seems unlikely that Omninet will be adopted as a US standard, in Europe and Japan it may indeed be more important than IEEE-802 standards.



**Fig 5—Although it's a proprietary network, Corvus Systems' Omninet is a virtual de facto bus LAN standard in Europe and Japan. You'll find that this low-cost, 4M-bps network is even easier to implement now that NEC has introduced its single-chip design solution for an Omninet-II PC-LAN node, the  $\mu$ PD72105 LAN controller IC.**

Phil Belanger, director of network architecture for Corvus, attributes the popularity of Omninet outside the US to the inability of IBM to dominate foreign LANs, and to Omninet's attraction as a low-cost alternative to Ethernet. Furthermore, Corvus designed Omninet primarily for PCs from the start.

The ARCnet token-passing PC-LAN system works

## For more information . . .

For more information on the LAN-node ICs and boards described in this article, circle the appropriate numbers on the Information Retrieval Service card or contact the following manufacturers directly.

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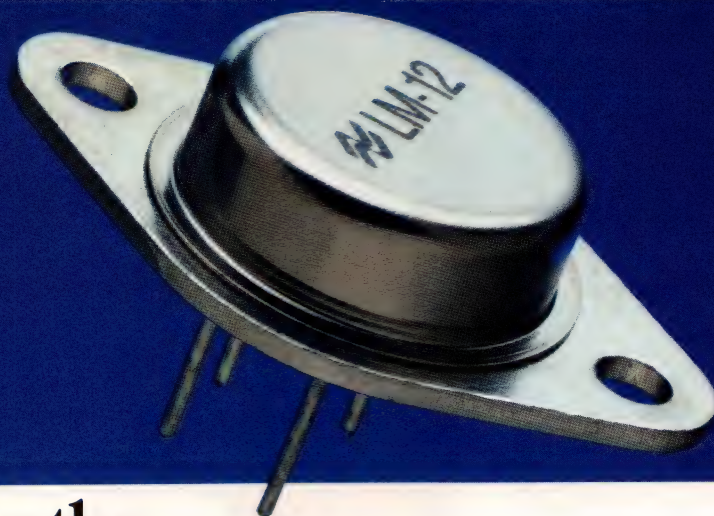
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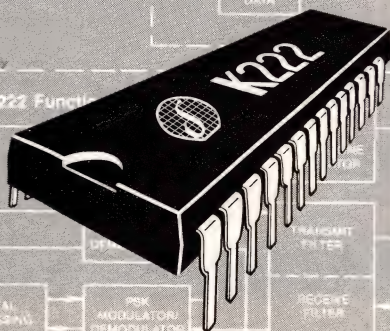
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Silicon Systems' K-Series modem family IC's are fully compatible, allowing existing 1200 bps modems that were designed with the SSI K212 to be enhanced with the SSI K222 by plugging the K222 into the K212 sockets. In the same way, 2400 bps operation can be added using future SSI K-Series family members.

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For more information on the SSI K222 and the evolving SSI K-Series modem IC family, contact: **Silicon Systems**, 14351 Myford Road, Tustin, CA 92680. (714) 731-7110, Ext. 575.

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at 2.5M bps using RG-62 coaxial cable. It has also been implemented in a single-chip controller IC, the 40-pin COM9026 from Standard Microsystems. Introduced in 1981, the COM9026 LAN controller (Lane) was in fact the industry's first single-chip LAN controller chip. The Lane works with the 16-pin COM9032 LAN transceiver IC. Last April, the company began supplying the device in a plastic DIP for \$32.80 (100), a 30% reduction in price over the ceramic-DIP version.

One general-purpose controller chip—the WD2840A from Western Digital—conforms to no specific standard but helps you build proprietary 1.1M-bps token-passing PC-LAN nodes. This NMOS part employs dual DMA channels for buffer-chaining to support a frame format similar to IBM's High-level Data Link Control (HDLC). Supplied in a 48-pin DIP, the WD2840A sells for \$44 (100).

Whether by default, as when DEC's VT-100 became ASCII, or by design, as with JEDEC packaging standards, you can count on the emergence of an eventual, worldwide industry standard for PC-LAN nodes. If nothing else, designers and users will eventually demand a LAN standard, or simply start using one that makes the most sense to them. Chip makers are sure to follow suit.

**EDN**

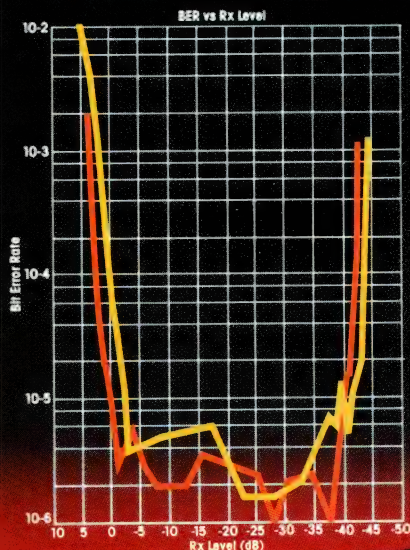
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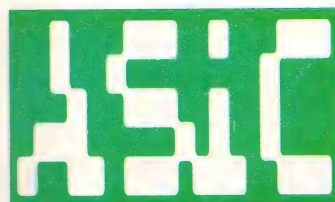
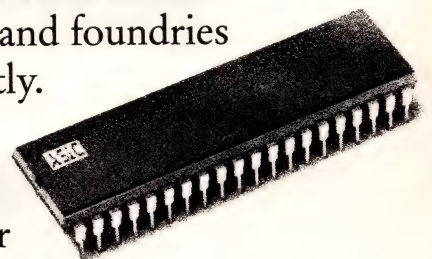
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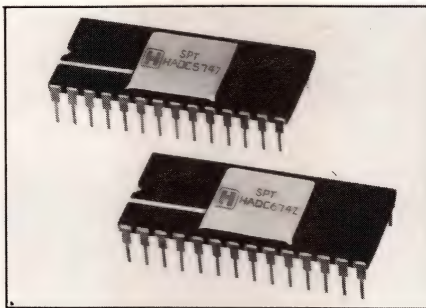
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## Monolithic, 12-bit 574/674-type ADC contains on-chip sample/hold amplifier

The HADC574Z/674Z 12-bit successive-approximation A/D converters are pin compatible with industry-standard 574 (25- $\mu$ sec) and 674 (15- $\mu$ sec) types. Moreover, the two monolithic devices each contain an on-chip sample/hold amplifier, a circuit function that's not available on other 574/674s.

The S/H block makes use of the on-chip DAC's capacitor network. Also integrated on the chip are the successive-approximation register, a clock oscillator, a reference, the input comparator, control logic, and 3-state output buffers. The manufacturer uses a bipolar-enhanced CMOS process called BEMOS to



manufacture the converters.

The BEMOS process combines CMOS logic with fast bipolar npn transistors. A laser-trimming step adjusts the offsets in the DAC and the comparator; it also trims linearity and gain errors. Full-temperature linearity of 12 bits ensures that

the converter exhibits no missing codes.

By using the pertinent input pin, you can select full-scale ranges of 10 or 20V; a bipolar-offset pin also allows you to use the A/D converter with bipolar input signals. The devices operate from 5V and  $\pm 12$  to  $\pm 15$ V supplies and dissipate 150 mW max. The HADC574Z costs \$26.90; the HADC674Z sells for \$36.40 (100).

**Honeywell Signal Processing Technologies, 1150 Cheyenne Mountain Blvd, Colorado Springs, CO 80906. Phone (303) 577-1000.**

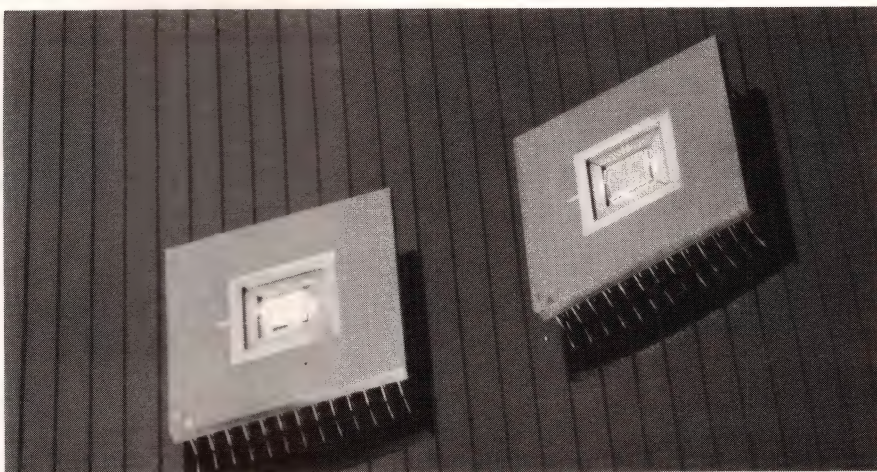
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## 32-bit floating-point CMOS chip set can handle graphics and image processing

The TMC3200 floating-point ALU and the TMC3201 floating-point multiplier form an IEEE-754-compatible CMOS floating-point chip set. In pipeline mode, the ALU provides throughput of 10M flops; the multiplier operates at 8M flops. The ALU's clock rate is 20 MHz, the multiplier's is 16 MHz.

The chip set supports the TRW extended-range, 34-bit floating-point data format; the IEEE 32-bit, single-precision floating-point format; and the 24-bit, 2's-complement integer fixed-point format. The parts feature two 17-bit input buses and a single 17-bit output bus. A single pipeline register is included on chip. The internal accumulate path of the ALU is 34 bits wide.

The chip set is suitable for application in graphics and image proc-



essing, floating-point digital filters and FFTs, and radar and sonar signal processors.

The CMOS chip set dissipates 0.16W. The chips come in 88-pin pin-grid arrays. The 0 to 70°C versions of the TMC3200 and TMC3201

cost \$124; the -55 to +125°C versions cost \$273 (1000).

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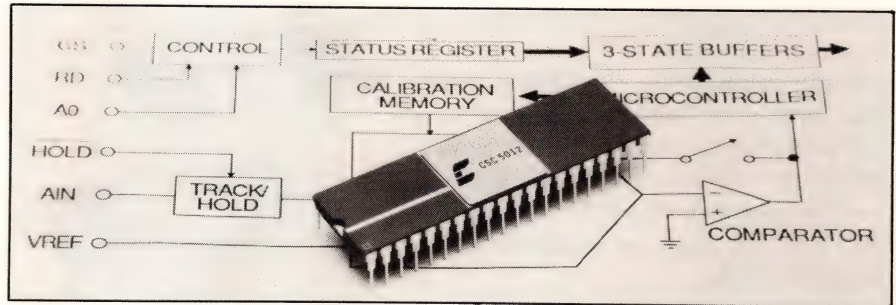


## Self-calibrating data converters offer as much as 16 bits of resolution

The CS501X Series sampling A/D converters provide as much as 16 bits of resolution at throughput rates to 63 kHz. These monolithic converters offer 12- to 16-bit resolution. All models include microcontrolled self-calibration, so they exhibit  $\pm 1/2$ -LSB accuracy that's independent of time and temperature.

The CMOS devices incorporate a track/hold input, microprocessor interfaces, and digital interfaces with 3-state output buffers. The manufacturer compensates for any offsets caused by poor threshold matching.

The converters use a RAM-based calibration scheme to reset and calibrate at power-up. You can control



the calibration or set the chip to calibrate itself continuously. The first chip in the series, the CS5012, is a 12-bit converter in a 40-pin ceramic DIP. It operates from  $\pm 5$ V supplies and dissipates 150 mW typ.

The CS5012-KC24, specified for sampling rates as high as 33.3 kHz, costs \$34 (100). The -KC12 version,

specified for sampling rates as high as 62.5 kHz, costs \$45 (100).

**Crystal Semiconductor Corp., Box 17847, Austin, TX 78760. Phone (512) 445-7222. TWX 910-874-1352.**

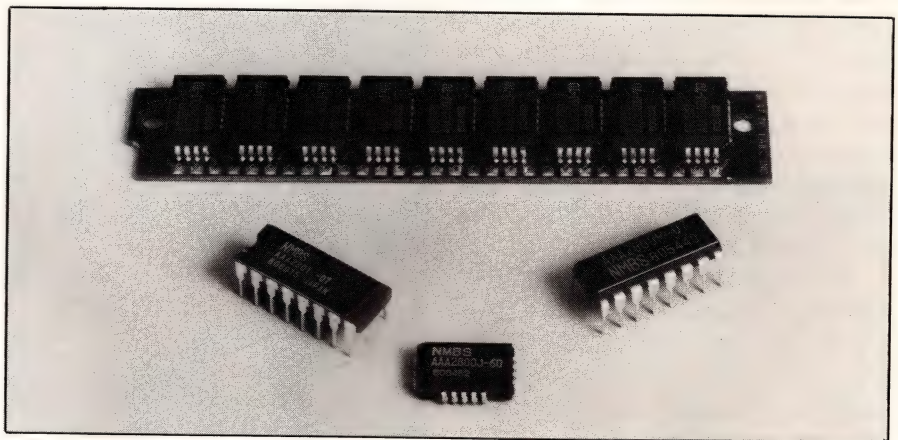
Circle No 662

## 60-nsec RAS access time boosts throughput in CMOS dynamic RAMs

The AAA2800 Series CMOS dynamic RAMs feature 60-nsec RAS access times. The parts, organized as  $256k \times 1$  bits, feature a static column mode. After the initial row address is latched, this mode allows the memory to behave as a 512-bit RAM with a 25-nsec access time. This feature is useful in graphics systems and in cache-memory transfer, for which high bandwidth is particularly important.

The AAA2801 possesses an enhanced page mode, which allows you to latch the column address on the falling edge of  $\overline{\text{CAS}}$  so that system pipelining of addresses can take place. The AAA2802 features a nibble mode that allows sequential data access in groups of four bits.

The AAA2800 devices come in



16-pin plastic DIPs, 16-pin ceramic DIPs, and 18-pin plastic leaded chip carriers in 60-, 70-, 80- and 100-nsec versions. They're also available in single-in-line memory modules in 70-, 80-, 100-, and 120-nsec versions. Samples of the AAA2800 Series dy-

namic RAMs cost \$7 to \$8.

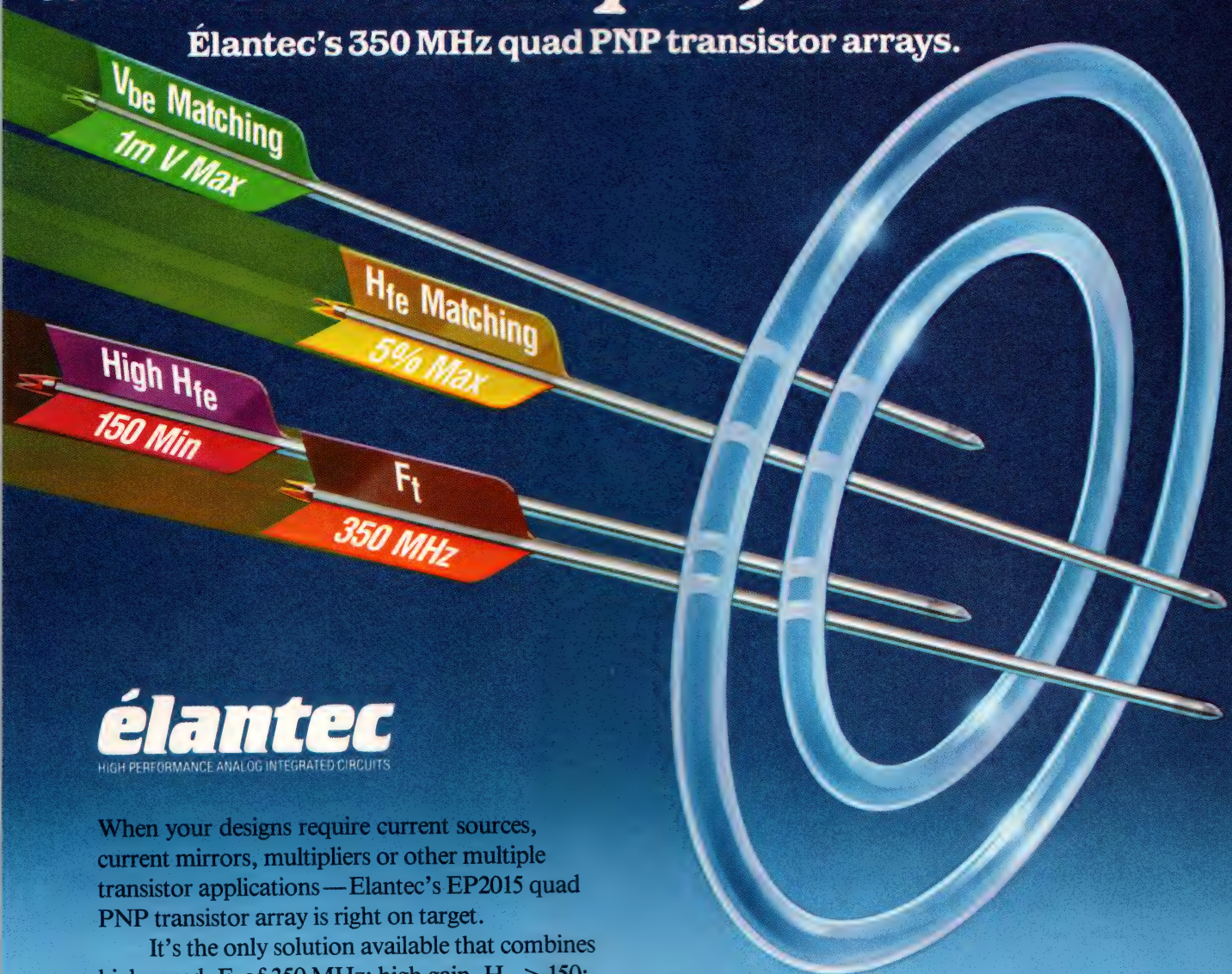
**NMB Semiconductor Corp., 4677 Old Ironside Dr, Suite 370, Santa Clara, CA 95054. Phone (408) 727-2636.**

Circle No 666



# Matched parameters with unmatchable performance.

Élantec's 350 MHz quad PNP transistor arrays.



**élantec**  
HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

When your designs require current sources, current mirrors, multipliers or other multiple transistor applications—Elantec's EP2015 quad PNP transistor array is right on target.

It's the only solution available that combines high speed,  $F_t$  of 350 MHz; high gain,  $H_{fe} > 150$ ; and tight parametric matching,  $\Delta V_{be}$  of 1mV max—all crucial to design predictability. And the single chip configuration assures excellent thermal tracking, high density and easy handling.

The EP2015 is the first monolithic quad array with matched PNP transistors that are dielectrically isolated (DI) from one another by a layer of glass. This results in low collector-to-substrate capacitance that allows high speed performance and complete DC isolation. In addition, SCR effects have been removed and crosstalk virtually eliminated compared to junction isolated arrays. And voltage breakdown ( $BV_{ceo}$ ) is 40 V minimum.

The EP2015 is pin compatible with the TPQ3906 and MPQ3906 and available in 14 pin plastic and CERDIP, as well as in die form for use in hybrid applications. With prices as low as

\$1.40 in quantities of 100. Military and commercial versions are both available. And a complementary NPN array, the EN2016, is coming soon and will be followed by other array products.

We aim to please. And to prove it we offer the industry's only two-for-one guarantee on all our devices.

To find out more about our arrow-dynamic EP2015 quad PNP transistor array—contact Elantec. Where élan is more than just a name. 1996 Tarob Court, Milpitas, CA, (800) 821-7429. In California, (408) 945-1323.

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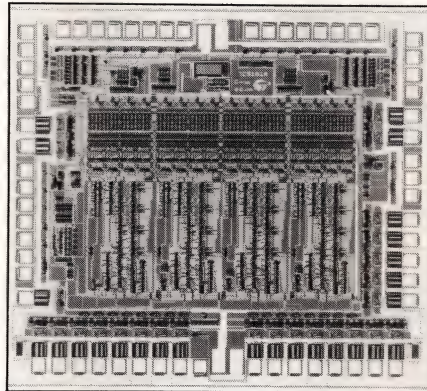
TM



## 16-bit-slice CMOS $\mu$ P outperforms four cascaded 4-bit-slice bipolar $\mu$ Ps

The CY7C9101-30 16-bit-slice microprocessor outperforms four CY7C901-23 4-bit-slice microprocessors by as much as 40%, according to the manufacturer. The part is compatible with the microcode for the 2901 4-bit-slice  $\mu$ P. Furthermore, a pin-compatible alternate version of the CY7C9101-30 is available from an alternate source.

The CY7C9101's function is identical to that of four cascaded (bipolar) 2901s with a 2902 carry-look-ahead unit. The  $\mu$ P uses  $\frac{1}{16}$  the power of the cascaded bipolar bit-slice designs. When a pipelined CY7C9101 system performs an add-



with-simultaneous-shift operation, the system's data-loop timing is 53 nsec, and control-loop timing is 67 nsec.

The CY7C9101 is available in an industry-standard 64-pin plastic or ceramic DIP for use over the commercial temperature range (0 to 70°C). It is also available in a 64-pin ceramic DIP, 68-pin LCC, or 68-pin pin-grid array for use over the military temperature range (-55 to +125°C). A 30-nsec commercial version in a plastic DIP costs \$50.25 (100); the 40-nsec version is \$34.80 (100).

**Cypress Semiconductor Corp., 3901 N First St, San Jose, CA 95134. Phone (408) 943-2666.**

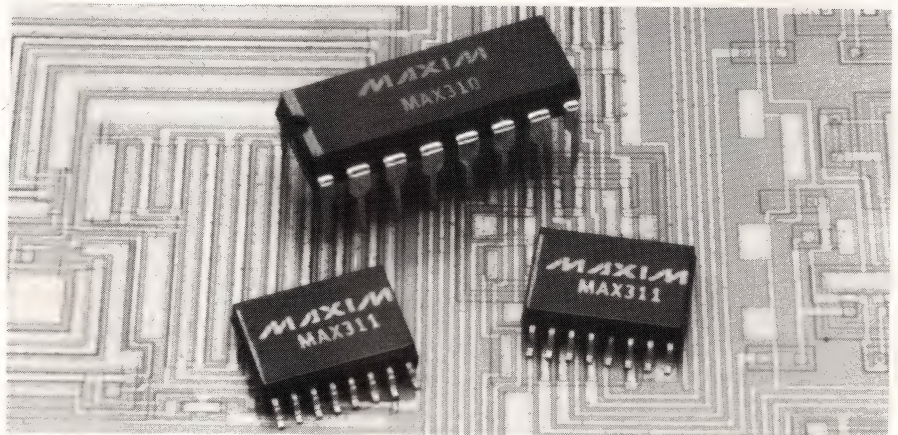
Circle No 663

## Analog multiplexers provide 76 dB typ of single-channel off-isolation at 5 MHz

The MAX310 and -311 CMOS analog multiplexers can switch RF, wide-band video, audio, and digital signals. The MAX310 is a 1-of-8 multiplexer; the MAX311 is designed for 2-of-8 applications.

The MAX310 and -311 feature an enhanced series-shunt-series T structure that provides 76 dB typ (66 dB min) of single-channel off-isolation at 5 MHz. The devices also exhibit <1° phase-shift match between channels at 5 MHz.

The multiplexers operate from  $\pm 4.5$  to  $\pm 18$ V supplies; when using  $\pm 15$ V supplies, they accept signals in the -15 to +12V range. Their channel on-resistance is 150 $\Omega$  typ. The units guarantee break-before-make switching and consume 1.1 mW. All the control inputs are compatible with TTL and CMOS logic.



Decoding takes place in BCD format. An enable input simplifies cascading of the devices.

The MAX310 and -311 are available in 16-pin plastic or ceramic DIPs and 16-pin small-outline packages. Prices range from \$8 for commercial parts (0 to 70°C) to \$14.40

(100) for military parts (-55 to +125°C). Devices rated for industrial use are also available.

**Maxim Integrated Products, 510 N Pastoria Ave, Sunnyvale, CA 94086. Phone (408) 737-7600.**

Circle No 667



# The fastest monolithic sample-and-hold amps in the galaxy? As far as we know, YES!

## Choose the performance you need!

In the fast-paced world of data acquisition, Harris gives you the range of sample-and-hold amplifiers to cover your most exotic design requirements — from the world's fastest to the one with longest hold time. Choice. Performance. Reliability. Availability. These are the reasons so many of your fellow analog designers stay a step ahead by specifying these Harris S/H amps:

- **HA-5330: Industry's Fastest.** Acquisition time,  $0.5 \mu\text{s}$  to  $0.01\%$ ! Droop rate,  $0.01 \mu\text{V}/\mu\text{s}$  with built-in  $90 \text{ pF}$  hold capacitor; DC gain,  $2 \times 10^7 \text{ V/V}$ ; aperture time,  $20 \text{ ns}$ .
- **HA-5320: Performance Leader.** For a wide range of 12-bit, high-speed systems.

Acquisition time,  $1.0$  to  $5 \mu\text{s}$ ; droop rate,  $0.05$  to  $0.005 \mu\text{V}/\mu\text{s}$  (for  $0$  to  $1000 \text{ pF}$  of added capacitance). DC gain,  $2 \times 10^6 \text{ V/V}$ ; aperture time,  $25 \text{ ns}$ .

- **HA-2420 and HA-2425: Universal.** Acquisition time,  $3.2$  to  $500 \mu\text{s}$ , depending upon the selected droop rate — from  $0.005$  to  $0.000005 \mu\text{V}/\mu\text{s}$ . DC gain,  $5 \times 10^4 \text{ V/V}$ ; aperture time,  $30 \text{ ns}$ ; slew rate,  $7 \text{ V}/\mu\text{s}$ .

Contact: Harris/MHS Semiconductor Sales Ltd., Eskdale Road, Winnersh, Wokingham, Berks, RG11 5TR, England.



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"So you think Harris sample-and-hold amps will improve my data acquisition system performance?"

"Precisely!"

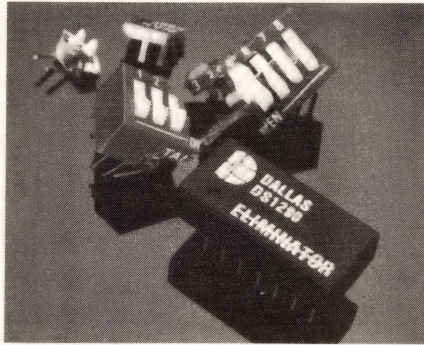




## Software-controlled DIP switch eliminates hand setting

The D1290 Eliminator is a CMOS DIP switch that's controlled by software. The switch, which comes in a 14-pin package, replaces the equivalent of an 8-station manual DIP switch. The DS1209 works in conjunction with the DS1206 Phantom Interface, which allows software to set the switch without interfering with system operation.

The DS1290 lets you choose whether to reprogram the switch settings on power-up or maintain the settings until an update is required. An embedded lithium power



source guarantees data retention for at least 10 years.

Another advantage of this device over mechanical switches is that it

eliminates pullup resistors. The DS1206 simply converts byte-wide data to 3-wire serial format for communication with the DS1290. The DS1290, which is housed in a 0.3-in.-wide plastic DIP, costs \$1.49 (10,000). A larger version, the DS1292, replaces 16 switches. It comes in a 22-pin package and costs \$1.99 (10,000). The DS1206 sells for \$0.99 (10,000).

**Dallas Semiconductor, 4350 Beltwood Parkway, Dallas, TX 75244. Phone (214) 450-0400.**

Circle No 668

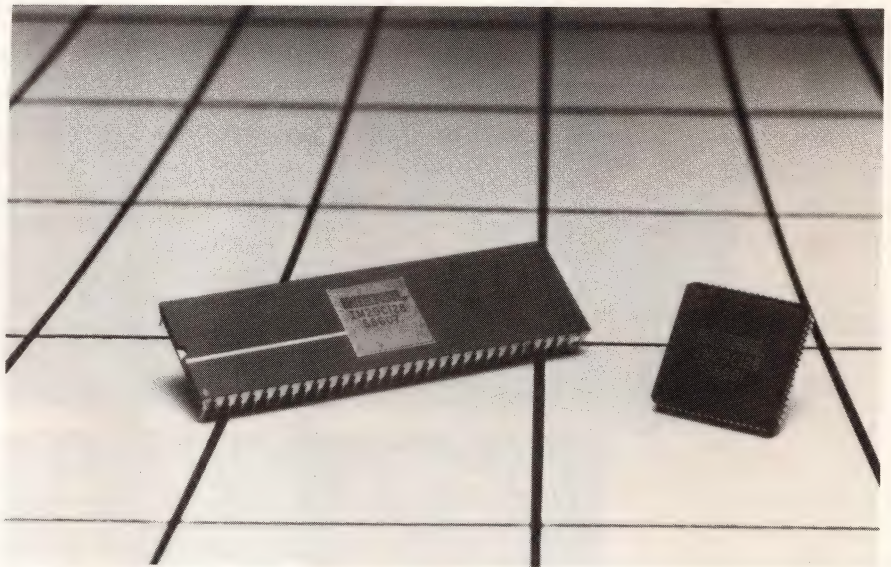
## 16-bit CMOS FIR-filter controller cuts circuit complexity and power consumption

The IM29C128 16-bit CMOS finite-impulse-response (FIR) filter controller provides all the data history, storage, and programmable filter-cycle control logic necessary to implement FIR filters with one to 128 taps.

The controller reduces circuitry for 128-tap (or smaller) filters having data paths as large as 16 bits and coefficients of 16 bits or more. When it's used with an external filter coefficient memory of as many as 128 words  $\times$  16 bits and a 16-bit (or less) multiplier/accumulator, the IM29C128 allows you to implement an FIR filter by using just three ICs.

The controller provides all the timing and control signals necessary to operate the multiplier/accumulator and the coefficient memory as 3-state devices. It also has an asynchronous interface.

The IM29C128 features an 80-



nsec min filter-cycle period with a 25-MHz master clock input; it's TTL compatible, and it incorporates a 16-bit data-I/O path and a 128-word  $\times$  16-bit RAM. You can cascade several IM29C128s for longer filters and faster throughput. The

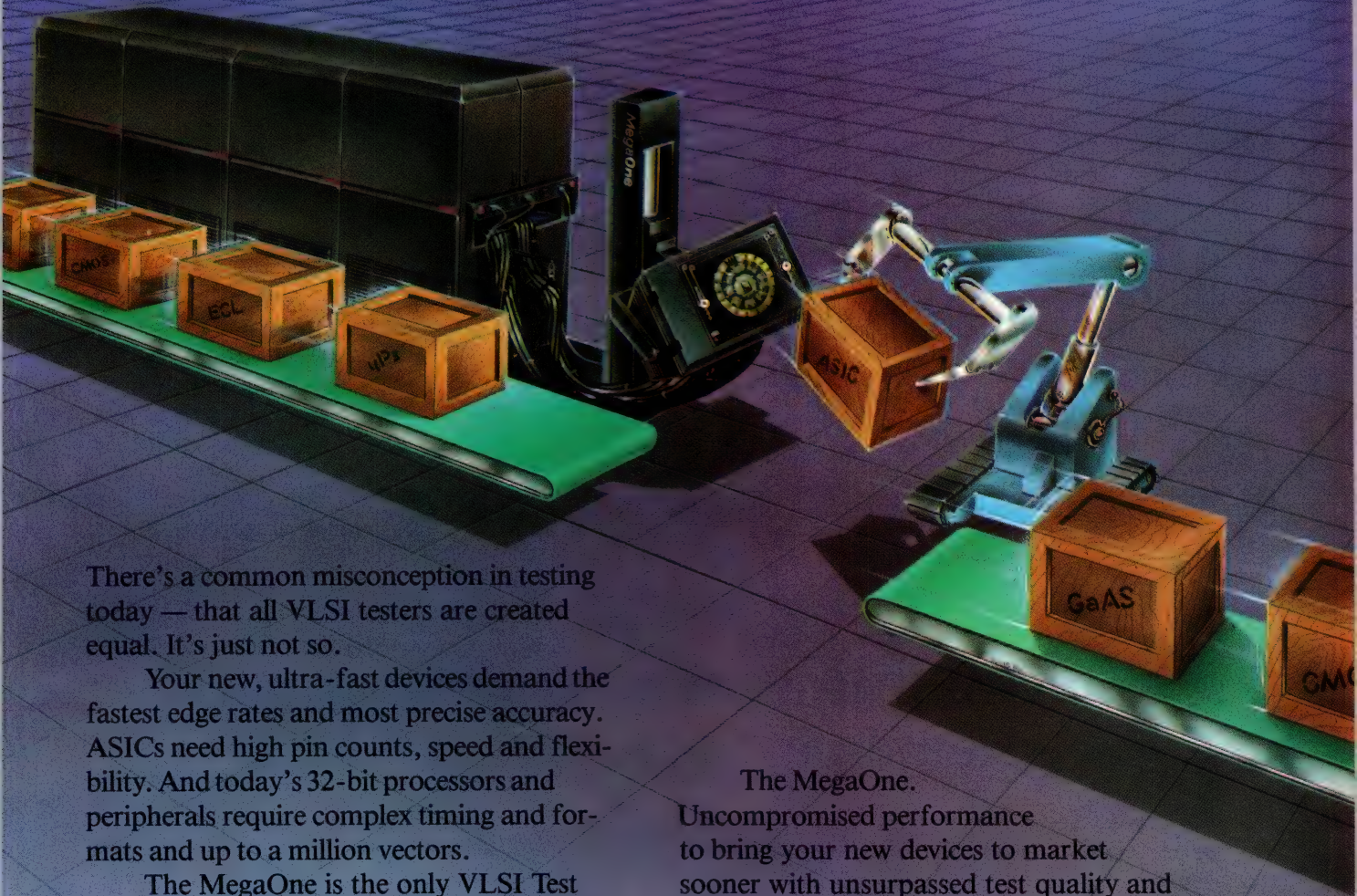
IM29C128 is available in 68-pin PLCCs and 64-pin DIPs for \$37.75 (100).

**GE/Intersil, 10600 Ridgeview Ct, Cupertino, CA 95014. Phone (408) 996-5000.**

Circle No 669



# Uncompromised VLSI Testing The MegaOne and Only



There's a common misconception in testing today — that all VLSI testers are created equal. It's just not so.

Your new, ultra-fast devices demand the fastest edge rates and most precise accuracy. ASICs need high pin counts, speed and flexibility. And today's 32-bit processors and peripherals require complex timing and formats and up to a million vectors.

The MegaOne is the only VLSI Test System that is equal to the task. It provides uncompromised test quality over all real world test conditions. For all technology and device types.

The MegaOne is not the focused, short-cut approach others offer which compromises test quality. It delivers the fastest, most accurate edges for all formats (not just a few). And the new ACPMU offers 3 picosecond precision. The MegaOne has up to 256 channels with full Tester-Per-Pin resources. Each operating without restriction at 40 or 80 MHz with timing on-the-fly, a million vectors and 3 edges per pin.

And only the MegaOne guarantees all specifications at the DUT pin, handler, or probe tip, where you need it.

## The MegaOne.

Uncompromised performance to bring your new devices to market sooner with unsurpassed test quality and unmatched cost efficiency. And backed by Megatest. A company with a 10 year track record of unbeatable solutions and unequalled worldwide service and support.

Find out more about why only the MegaOne can meet all your VLSI test needs. Contact us for our white paper "*VLSI Testing is No Place for Compromise.*" Megatest Corporation, c/o Marketing, 1321 Ridder Park Drive, San Jose, CA, 95131. (408) 971-TEST.

The MegaOne and only.

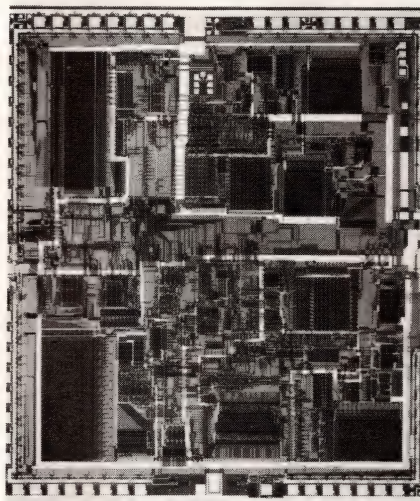
**MEGATEST**  
Performance without Compromise



## Compression/expansion processor supports bit-boundary control for bit-mapped images

The Am7971 compresses and expands 2-tone bit-mapped images or documents to reduce storage requirements and data-transmission times for systems handling bit-mapped data. In contrast with the byte-boundary capability of its predecessor (the Am7970A), the Am7971 features two programmable registers to provide bit-boundary control, thus allowing users to define document sizes to the nearest bit, or pixel.

The 7971 handles page widths to 16k pixels per line (in contrast with the 7970A's 4k pixels per line), thus enabling it to process documents as wide as 3.4 feet at 400 pixels/in. It



addresses as much as 16M bytes on the CPU bus and optional local-document-store bus. It provides 2- to 12-MHz pixel rates with 5- and 8-MHz clocks.

The device compresses and expands data in accordance with CCITT recommendations T.4 and T.6 for groups III and IV facsimile equipment; compression ratios can be as high as 50:1 (see EDN, October 30, pgs 173-183). \$142.86 (100) for a version packaged in a 68-pin LCC.

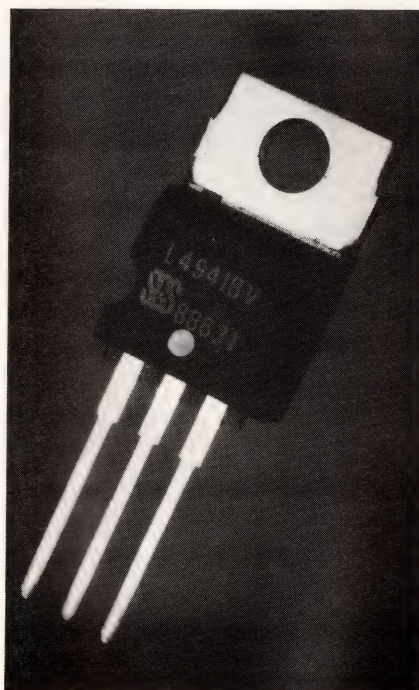
**Advanced Micro Devices Inc.,  
Box 3453, Sunnyvale, CA 94088.  
Phone (408) 732-2400.**

Circle No 664

## 5V regulator features low dropout voltage and low ground-pin current at full load

By incorporating an isolated-collector, vertical-pnp power transistor, the L4941 5V/1A voltage regulator achieves a typical dropout-voltage rating of 450 mV (700 mV max) at full load, suiting it to use in battery-powered equipment or as a post-regulator. The dropout voltage at a load current of 100 mA is typically 150 mV. In addition, the device features a typical ground-pin current of 35 mA (50 mA max) at full load.

The regulator operates with input voltages as high as 16V, but it withstands inputs as high as 40V without damage. It also withstands reverse-voltage inputs as great as -15V. Line regulation specs at 5 mV typ (25 mV max) for an input swing from 6 to 16V and a load current of 5 mA. Load regulation is 15 mV typ (35 mV max) for a load



current change from 50 mA to 1A. You can operate the regulator with an output capacitor as low as 10  $\mu$ F. Tolerance on the absolute output voltage is  $\pm 2\%$  when the junction temperature is 25°C, the input voltage 14V, and the output current 5 mA.

The L4941 is fully protected against thermal overloads and output short circuits. It comes in a TO-220 package and costs approximately \$0.70 (100,000).

**SGS Microelettronica SpA, Via C  
Olivetti 2, 20041 Agrate Brianza,  
Italy. Phone (039) 65551. TLX  
330131.**

Circle No 560

**SGS Semiconductor Corp, 1000 E  
Bell Rd, Phoenix, AZ 85022.  
Phone (602) 867-6100.**

Circle No 672



# COOLFETs take the heat off Power MOSFETs.

When you're looking for Power MOSFETs that know how to beat the heat, look no further than the performance leaders:

COOLFET™ Power MOSFETs from Fairchild.



Featuring the lowest  $R_{DS(on)}$  in the industry – a full 20% lower. So you enjoy substantially less power loss, resulting in the coolest operation around. Which adds up to an increase in reliability and efficiency you simply can't find anywhere else.

Whether you use them as drop-in replacements or for new designs, COOLFETs provide higher performance with no price penalty. In new designs, they call for smaller heat sinks. So they take up less space, and deliver significantly increased power density.

What's more, we've just added 16 new COOLFETs to our broad line of over 300 Power MOSFETs.

As with all Fairchild products, COOLFETs are backed by our extensive customer service and support. Including fast delivery. Excellent sample availability. And field technical specialists to provide any and all assistance you may need.

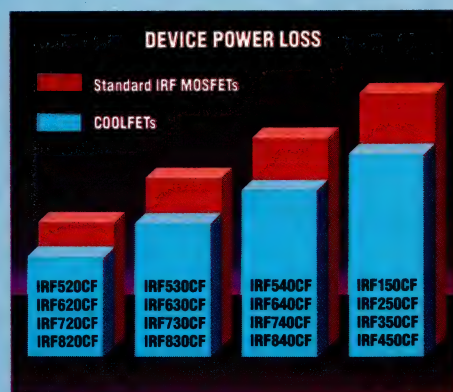
To order COOLFETs, simply add a CF suffix to your regular IRF MOSFET part number.

For more information, contact your local Fairchild sales office or distributor. Or call our Customer Information Center at 1-800-554-4443.

## COOLFETs

COOLFETs from Fairchild. When the heat's on, they never lose their cool.

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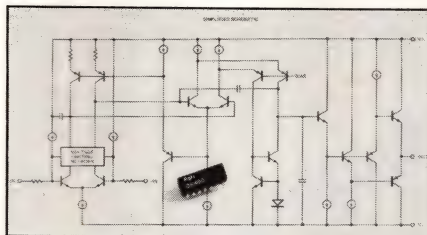
A Schlumberger Company



## Quad op-amp chip draws 2.9 mA max; offset voltage is less than 150 $\mu$ V

The OP-400 monolithic quad op amp meets or exceeds the performance offered by the company's OP-07, yet consumes less than one quarter of the power (per amplifier) that the OP-07 consumes. The OP-400's maximum supply current is 2.9 mA for all four amplifiers; for the single OP-07, that spec is 4 mA. Compared with single op amps, monolithic quad op amps offer such advantages as tight parametric matching between amplifiers.

Input offset voltage for the OP-400 is 150  $\mu$ V max; its input



offset voltage drift is 1.2  $\mu$ V/ $^{\circ}$ C max over the military and industrial temperature ranges. The part's voltage gain is 5,000,000, and its input bias current is 3 nA max. Its common-mode rejection is 120 db min, and its power-supply rejection

is 115 dB. The OP-400 can drive loads of as much as 10 nF.

The device is available in 14-pin ceramic DIPs specified for operation over the industrial and military temperature ranges. The company plans to offer the device in an LCC in the second quarter of 1987. Prices for the op amp are \$5.75 (industrial), \$17.90 (military), and \$23.90 (military 883C grade) (100).

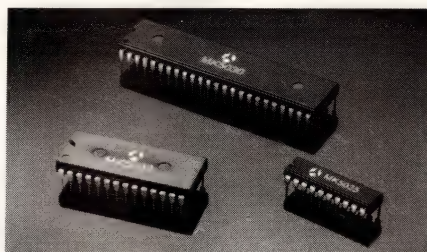
**Precision Monolithics Inc, 1500 Space Park Drive, Santa Clara, CA, 95052. Phone (408) 727-9222.**

Circle No 670

## Hub-controller and encoder/decoder ICs implement LAN nodes for 1M-bps StarLAN

The MK5030 and MK5035 ICs allow you to build LAN-node cards for an IEEE-802.3 StarLAN, a 1M-bps LAN that uses standard twisted-pair telephone wiring. Both devices feature automatic compensation for polarity reversals in the network wiring, which can occur inadvertently during installation. The ICs conform to all IEEE-802.3 requirements.

The MK5030 StarLAN hub-controller chip coordinates data transmission between network stations on as many as 12 radial LAN links. Status outputs indicate network data transmissions, data collisions, and the automatic disconnection of faulty stations that have entered a continuous-transmission (jabber) mode. For large systems with stacked network hubs, the MK5030 incorporates an automatic preamble-generation function. This function replaces preamble bits that are



lost when data passes through different levels of a hub stack and is resynchronized to a new clock source. If necessary, you can bypass the resynchronization logic, so that multiple MK5030s appear to the network as a single hub. The hub controller operates from a 6-MHz clock to minimize EMI emissions at the FCC and VDE test frequency of 30 MHz, and it tolerates 167 nsec of jitter on the Manchester-encoded data transitions.

The MK5035 Manchester encoder/decoder interfaces a variety of MAC (Media Access Control) chips to the StarLAN network. In addition

to its internal collision-detection capabilities, the device has a collision-detection input pin that allows you to implement external collision-detection circuitry. It also includes the multipoint-extension (MPE) and station-disconnect functions employed in more advanced StarLAN networks.

Both the MK5030 and MK5035 are 5V-only CMOS ICs. The MK5030 comes in a 48-pin DIP, the MK5035 in a 20-pin DIP. The parts cost less than \$50 and \$10, respectively (OEM qty).

**Thomson Semiconducteurs, 45 Ave de l'Europe, 78140 Velizy, France. Phone (1) 39469719. TLX 240780.**

Circle No 561

**Thomson Components-Mostek Corp, 1310 Electronics Dr, Carrollton, TX 75006. Phone (214) 466-6000.**

Circle No 671





**Recently, a customer called to tell us that they installed 25,000 Aeroflex custom hybrids without a single failure. We weren't surprised.**

We can't tell you their name. But we can tell you that they are a major military prime contractor. A Fortune 100 company, one of the many on our client roster.

And in four long years, they haven't found it necessary to reject an Aeroflex hybrid. Not one. Ever.

That's quite a record. But, for us, not all that unusual.

Albeit we don't get accolades like this everyday. But we do get another kind of tribute to our performance. Often.

We get it in reorders. And in new customers (one of whom rates us as one

of the top four custom hybrid houses in the country).

We get tough customers with stringent requirements that interface with our own tough standards. Requirements that challenge us to new innovations—fresh concepts in video amplifiers, drivers, digital interface circuits, active filters, low-noise pre-amplifiers and more.

Aeroflex produces cost-effective new solutions in thick and thin film technologies and new packaging approaches in both hermetically-sealed all metal cases and epoxy-sealed ceramics.

In today's increasingly competitive technologies, a track record for reliability is essential. For over twelve years Aeroflex has maintained an extraordinary pattern of creative consistency in both military and industrial applications. We don't just settle for meeting the requirements of MIL-STD-1553, MIL-Q-9858A, MIL-STD-883 and MIL-I-45208—we exceed them.

Unit after unit, year after year.

For details, call 1-516-694-6700 or TWX 510-224-6417, or write Aeroflex Laboratories, Microelectronics Division, 35 South Service Rd., Plainview, NY 11803.

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# **32-BIT RAPID DEPLOYMENT FORCE.**





Intel's new military MG80386 microprocessor is now ready for immediate deployment.

We mean right away. Right off-the-shelf. Which means you can quickly get your design

into production with all the benefits of Intel's world-class manufacturing capability.

Including our 1.5 micron CHMOS III process. The technology that provides both low power consumption and high total dose radiation tolerance (in excess of 100K RADS Si). Allowing you to build high performance, high radiation-tolerant systems that save space, weight and power.

Best of all, you get steady continuity of supply. Because CHMOS III is a proven technology that's delivered hundreds of thousands of successful products for years.

But continuity of supply is only half the story.

Consider that the MG80386 is the only 32-bit chip to provide complete hardware support for multitasking on-chip. Included in the CPU is a Memory Management Unit that provides support for virtual memory opera-

tions, optional on-chip paging and four levels of software protection.

Which makes it ideal for military applications that require a high degree of security and lightning-fast speed.

Military designers

<u>VHSIC</u>	<u>MG80386</u>
• Functional Throughput Rate	$3.0 \times 10^{12} \frac{\text{Gates} \cdot \text{Hz}}{\text{CM}^2}$
• Radiation Tolerance (Total Dose)	$>10^5 \text{ RADS (Si)}$
• Input Clock Frequency	32 MHz
• Chip Density	Approx. 90,000 Gates (275,000 transistors)

*The MG80386 gives you a blazing 3.5 to 4 MIPS with a functional throughput that exceeds VHSIC product performance requirements.*

will also appreciate all the development support available for the MG80386. Like Fortran, C and Intel's own ADA™ language compiler. Which provides the most useful and most used language on easy-to-use development systems.

For more information on the MG80386, call Intel toll-free: (800) 548-4725. Or write Intel Corporation, Lit. Dept. W-324, 3065 Bowers Ave., Santa Clara, CA 95051.

And get our rapid deployment force fighting on your side.

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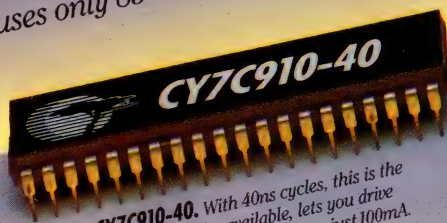
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# 16-Bit-Slice CMOS



**16-bit-slice CY7C9101-30.** Replaces four 4-bit-slice parts or more, uses only 85 mA, goes 30ns, or better.



**Controller CY7C910-40.** With 40ns cycles, this is the fastest CMOS 12-bit controller available, lets you drive our 16-bit-slice at record breaking speeds. Uses just 100mA.



**CY7C403-25, CY7C404-25 Cascadeable FIFO**  
64 × 4 or 64 × 5 parts offer 25MHz speeds, virtually no bubble-through. Super buffers for high performance applications.



**PAL C22V10-25W. Erasable PLD.**  
Shrink your board and speed your system even more with fast, 25ns half-power reprogrammable logic.



**CY7C150-15 1024 × 4 SRAM.**  
0.8-micron SRAM goes where no 4K has ever gone before: 15ns, for lightning fast cache memory with reset feature.



**CY7C128-25 2048 × 8 SRAM.**  
0.8-micron technology for the fastest speeds in memory: 16K densities, 25ns performance.

## Go where no designer has ever gone



# 30ns:

## ***Some applications require an efficient instruction set and brute performance.***

Such as high speed controllers, emulators, accelerators, and the like.

Here's why a designer using bit-slice can attain performance beyond monolithic microprocessors:

### ***Performance = execution speed × instruction efficiency.***

**Execution speed:** A bit-slice CPU executes instructions faster than a microprocessor.

**Instruction efficiency:** Since bit-slice executes a microcoded instruction set, you can create your own application specific solutions. So your system executes *in hardware* where a microprocessor must wade through a software subroutine.

That's how to go where no microprocessor will take you.

### ***Here's how to go where no other bit-slice will take you:***

Forget old bit-slice power and size limitations: In the past (last year!) bit-slice speed came with real estate and power penalties.

A 16-bit-slice system needed four giant, power hungry 4-bit-slice chips, plus logic consuming more than one Amp.

No more. 16-bit-slice on one 64-pin chip. In power-sipping (85mA) CMOS.

You *now* have the hardware to rethink the high performance subsystem designs you need to turbo past your competitors.

That is why we're here. We have an entire family of high speed, low power parts designed to help you build faster, cooler, smaller systems.

### ***CMOS High Speed Logic Family***

In addition to the world's fastest 16-bit-slice and our 4-bit-slice microprocessors,

we offer the world's fastest 12-bit controllers, the fastest  $16 \times 16$  multipliers, and more high-speed CMOS circuits. Also, the fastest available 4-bit and 5-bit cascadeable FIFOs (25MHz performance).

### ***CMOS High Speed SRAM Family***

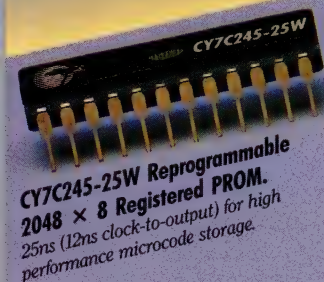
Featuring the *fastest* (15ns) 4K static TTL-compatible RAMs you can buy. Plus a variety of 15ns, 25ns, 35ns, and 45ns parts, too. Nibble-wide, bit-wide, byte-wide, ranging from 64-bits through 64K-bits. Low active power. Low standby power—many parts include auto-power-down when deselected. A superset of functions, including separate I/O, provides a design edge for improving overall system performance.

### ***CMOS High Speed PROM Family***

Surpassing bipolar with the *fastest* registered PROMs at  $\frac{1}{2}$  bipolar power, or less. Parts feature speeds to 25ns set-up, 12ns clock-to-output; all with low CMOS power. Byte-wide family available in 4K, 8K, 16K, 64K densities. Also, 8K, 16K, 64K non-registered available. EPROM memory technology permits 100% testing of data bits before packaging to provide optimum programming yields, plus *windowed parts* for the convenience of reprogramming.

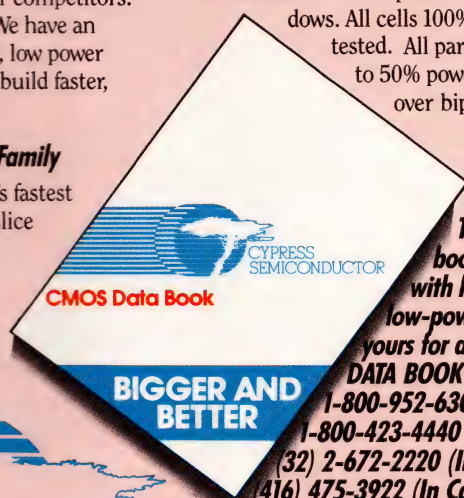
### ***CMOS High Speed PLD Family***

Featuring 25ns HALF-power 90mA *windowed* 22V10 EPLD—the new high-speed re-programmable PLD standard. The family also includes quarter-power 45mA PAL® 20 parts, and 55mA PLD 24 parts, both available at 25ns speeds and in *windowed*. All cells 100% functionally tested. All parts with up to 50% power savings over bipolar.



**CY7C245-25W Reprogrammable 2048 × 8 Registered PROM.**  
25ns (12ns clock-to-output) for high performance microcode storage.

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***This data book, packed with high-speed, low-power parts, is yours for a phone call.***  
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**1-800-423-4440 (In CA).**  
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**(416) 475-3922 (In Canada).**

**Ask for Dept. C136.**



## CYPRESS SEMICONDUCTOR



# ROCKWELL SEMICONDUCTOR TECHNOLOGY DELIVERS 1200 BPS AT 300 BPS PRICES. (Off-The-Shelf)

**Introducing Rockwell's new R212AT smart modem device set featuring Automatic Adaptive Equalization.**

Rockwell International's exclusive Automatic Adaptive Equalization Algorithms automatically enable the modem to adapt to any quality of phone line. Even signals over poor lines are enhanced to ensure virtually error-free transmission.

The R212AT smart modem device set is the most cost effective communications solution available for personal computers. And R212AT has implemented in silicon the software necessary for compatibility with the industry standard "AT" command set. This allows quick design-in because we've presolved all the "AT" dialing functions. It incorporates auto dial, auto answer and can dial

DTMF tones or pulses.

The R212AT smart modem offers lower system cost because it incorporates the controller and analog filter circuitry required for modem communications in the device set itself. This reduces parts count, enhances total system reliability and meets low power requirements for portable applications.

As well as operating asynchronously, the R212AT has synchronous mode operation for higher transmission throughput.

**1200 BPS**

**Also available: Rockwell's R212DP.**

Ideal for remote diagnostics and other integral applications, it provides specific advantages in price, performance and system cost savings.

**300 BPS**

The R212DP, like the R212AT, has automatic fall back to slower speeds and an RS232C interface. Both these Bell 212A and 103 compatible device sets are available at any level of integration from devices to boards or customized private label systems.

For ease of evaluation, Rockwell provides a board level evaluation modem for laboratory analysis to assure the performance and quality of R212AT and R212DP.

Call your local Rockwell distributor today for off-the-shelf delivery of an evaluation board complete with a Designer's Guide Kit.

## **Semiconductor Products Division**

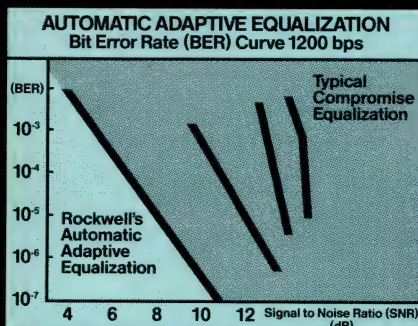
Rockwell International, P.O. Box C,  
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CA 92658-8902 (800) 854-8099.  
In California (800) 422-4230.



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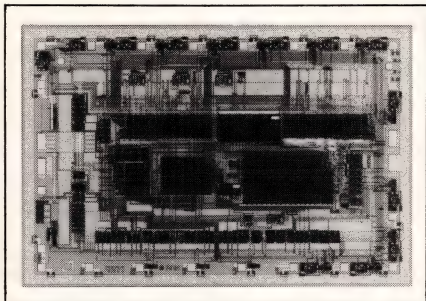
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# ICs and Semiconductors



## TIMING IC

The Am2971 programmable event generator can be programmed to achieve 10-nsec resolutions between system timing events. The chip can replace counters, analog delay lines, and RC networks. The part features 12 programmable, registered outputs, which allow you to define as many as 12 independent timing signals. It also features programmable control of the timing sequence for start and stop functions.

The chip incorporates a 10- to 100-MHz multiplying phase-locked-loop crystal oscillator and is clocked by an external system clock. It can generate the clock signals required by address-multiplexed dynamic RAMs, and it is suitable for use in disk-drive control and in timing control for bit-mapped graphics.

In a 24-pin ceramic DIP, the part costs \$17.75 (100). The manufacturer also plans to offer the chip in a plastic DIP, a plastic leaded chip carrier, and an LCC.

**Advanced Micro Devices Inc., Box 3453, Sunnyvale, CA 94088. Phone (408) 732-2400.**

Circle No 628

## DIGITAL ATTENUATOR

The CDG4469 hybrid attenuator IC uses CMOS logic and level-translation circuitry with lateral DMOS switches to control a ladder network of resistors. The IC provides 256 levels of attenuation in 0.5-dB increments. Added attenuation ranges from 0 to 127.5 dB. The device introduces 4.5-dB max insertion loss.

The attenuator, which accommodates analog input voltages as high as 6V rms, has a constant input

impedance of 650 $\Omega$ . The device has a 15-MHz frequency range; it operates from  $\pm 6$  to  $\pm 15$ V supply voltages. When operating from  $\pm 15$ V supplies, it dissipates 0.5  $\mu$ W typ.

All inputs to the CDG4469 have diodes that protect the inputs against damage from high static voltages or electric fields. The manufacturer recommends, however, that you restrict input voltages to the specified  $\pm 8$ V absolute-maximum rating. The circuit comes in a DIP configuration having 0.9-in. row spacing. \$23.50 (100).

**Topaz Semiconductor, 1971 N Capitol Ave, San Jose, CA 95132. Phone (408) 942-9100.**

Circle No 631

## DSP IC

For high-speed processing of transversal filter functions, the IMS-A100 cascaded signal-processor IC integrates 32 multiplier/accumulator stages on a single chip. Each stage is capable of multiplying 16-bit data by 16-bit coefficients at a data rate of 2.5M samples/sec. For higher throughput, you can reduce the coefficient size to 12, 8, or 4 bits. For 4-bit coefficients, the chip's maximum data rate is 10M samples/sec.

The chip accumulates its 32 stages of 16 $\times$ 16-bit multiplication to 36-bit accuracy. A programmable barrel shifter on the output of the multiplier/accumulator array allows you to select a 24-bit word from these 36 bits. You can cascade devices by coupling the 24-bit output of one IMS-A100 to the cascade inputs of a second IMS-A100. An internal 32-stage, 24-bit shift register correctly synchronizes the cascaded result before it's added to the 24-bit barrel-shifter output of the second IMS-A100.

The IMS-A100 stores coefficients internally in two independent memory areas, each of which contains 32 16-bit registers that you can randomly access via the IMS-A100's  $\mu$ P interface. A software-programma-

ble control bit switches the two memory areas into the device's multipliers, so you can maintain one set of active coefficients while you update the device with a new set of coefficients.

Development support for the IMS-A100 comprises a simulator that runs on the company's IBM PC-based Occam development system.

Fabricated in CMOS technology, the IMS-A100 operates from a single 5V supply and has TTL-compatible I/O. It comes in an 84-pin pin-grid array and dissipates less than 1W. Samples cost around \$500.

**Inmos Ltd, Box 424, Bristol BS997DD, UK. Phone (0272) 290861. TLX 444723.**

Circle No 629

**Inmos Corp, Box 16000, Colorado Springs, CO 80935. Phone (303) 630-4000.**

Circle No 630

## BIPOLAR DAC

Fabricated with a complementary bipolar process, the AD568 12-bit DAC offers a settling time of 50 nsec typ to within a  $\pm 0.025\%$  error band. You can configure (by using jumpers) full-scale output-current ranges of  $\pm 5.12$  mA and 0 to 10.24 mA. By using an external op amp and an on-chip span resistor, you can configure the converter for output-voltage ranges of  $\pm 5.12$  and 0 to  $-10.24$ V. The compliance range of the current-output stage is typically  $+1.2$  to  $-2.5$ V.

Responsible for the AD568's speed is the IC's complementary bipolar process, which allows the manufacturer to make both npn and pnp transistors that have gain bandwidth products greater than 500 MHz,  $BV_{CEO}$  specs greater than 36V, and equal  $h_{FE}$  figures.

Nonlinearity specs for the AD568 comprise integral nonlinearity (straightness of the device's transfer function, drawn through end points) and monotonicity. The integral nonlinearity spec is  $\pm 0.5$  and  $\pm 0.25$



# ICs and Semiconductors

LSB max at 25°C for standard and premium-grade AD568s, respectively. Over 0 to 70°C, these specs are  $\pm 0.75$  and  $\pm 0.5$  LSB max. The model specified for -55 to +125°C operation specs  $\pm 0.5$  LSB max at 25°C and  $\pm 0.75$  LSB max over temperature. All models guarantee monotonicity over the full operating-temperature range.

Operating from  $\pm 12$  or  $\pm 15$ V supplies, the converter draws 32 mA typ from the positive supply and 8 mA typ from the negative supply. The D/A converter's digital inputs are compatible with TTL or 5V CMOS logic families. Housed in 24-pin, 300-mil plastic or ceramic DIPs, devices in the AD568 Series start at \$40 (100).

**Analog Devices Inc, 2 Technology Way, Norwood, MA 02062. Phone (617) 329-4700.**

Circle No 632

## 25-MHz 68020 $\mu$ P

Operating at processing speeds greater than one million Whetstones, the 25-MHz version of the 68020  $\mu$ P boasts the fastest speed available in a general-purpose  $\mu$ P. This 32-bit  $\mu$ P's 40-nsec clock period translates into 12.5-MIPS performance when the IC operates in burst mode. Its sustained throughput averages 5 MIPS, or seven times the performance specification of an 8-MHz 68000  $\mu$ P.

The 25-MHz, 1.5- $\mu$ m 68020, which is fabricated in single-layer metal with polysilicide, includes an on-chip instruction cache and 3-stage instruction pipeline. You can use the  $\mu$ P with the 20-MHz 68881 floating-point coprocessor, which adheres to the IEEE's P754 floating-point specification and provides more than 40 floating-point functions.

Available in a 114-lead pin-grid-array package, the 25-MHz 68020 sells for \$699 in OEM quantities and \$849 in sample quantities. The 20-MHz 68881 floating-point coprocessor costs \$568 in OEM quantities; samples sell for \$699.

**Motorola Inc, Microprocessor Products Group, Box 52073, Phoenix, AZ 85072. Phone (512) 440-2839.**

Circle No 633

## GaAs BIT-SLICE $\mu$ P

Operating at three times the speed of bipolar silicon versions, the gallium-arsenide (GaAs) implementation of the Am2900 bit-slice family of microprocessors can execute an instruction in as little as 14 nsec. Developed under a technology-exchange agreement with Advanced Micro Devices, which originated the 2900 Series, the GaAs version is microcode compatible with the silicon version.

The family comprises three chips. The VE29G01 is a 4-bit-slice microprocessor consisting of a 16-word $\times$ 4-bit, 2-port RAM; a high-speed ALU; and the associated shifting, decoding, and multiplexing circuitry. The VE29G02 is a look-ahead carry generator; the VE29G10A is a 12-bit microcontroller that controls the execution sequence of microinstructions stored in microprogram memory. The devices' I/O drivers are compatible with 100K ECL.

The VE29G01 and VE29G10A come in 52-pin ceramic LCCs; the VE29G02 comes in a 28-pin ceramic LCC. Engineering samples of the VE29G02 (\$225) are available within 30 days; samples of the VE29G01 (\$435) and VE29G1A (\$475) will be available in the first quarter of 1987.

**Vitesse Electronics Corp, 741 Calle Plano, Camarillo, CA 93010. Phone (805) 338-3700.**

Circle No 634

## FIFO MEMORY

The MV61902 and MV61903 are 1k $\times$ 9-bit, 10-MHz FIFO memories. The MV61902 incorporates FIFO-full and FIFO-empty flags, and the MV61903 features parity logic. The MV61903's parity logic checks parity

on 8-bit input data and creates a parity bit for output data. Both FIFOs feature a register—called a “dipstick” register—that allows you to program the amount of data shifted into the FIFO before the Dipstick flag output becomes active.

The FIFOs, each employing a dual-port RAM architecture, have independent shift-in and shift-out clocks. Separate input and output registers in the data path respectively feature a 0-nsec data-hold time and a 25-nsec max shift-out to data-valid delay. You can cascade the FIFOs in width and depth or use their asynchronous 3-state output-enable pins to multiplex data between parallel devices for faster FIFO systems.

The CMOS devices operate from one 5V supply and consume 250 mW max. Operation spans -40 to +85 °C. The parts are available in ceramic or plastic 28-pin DIPs. MV61902, \$55; MV61903, \$60 (1000).

**Plessey Semiconductors Ltd, Cheney Manor, Swindon, Wiltshire SN2 2QW, UK. Phone (0793) 36251. TLX 449637.**

Circle No 638

**Plessey Semiconductors, 3 Whatney, Irvine, CA 92718. Phone (714) 951-5212.**

Circle No 639

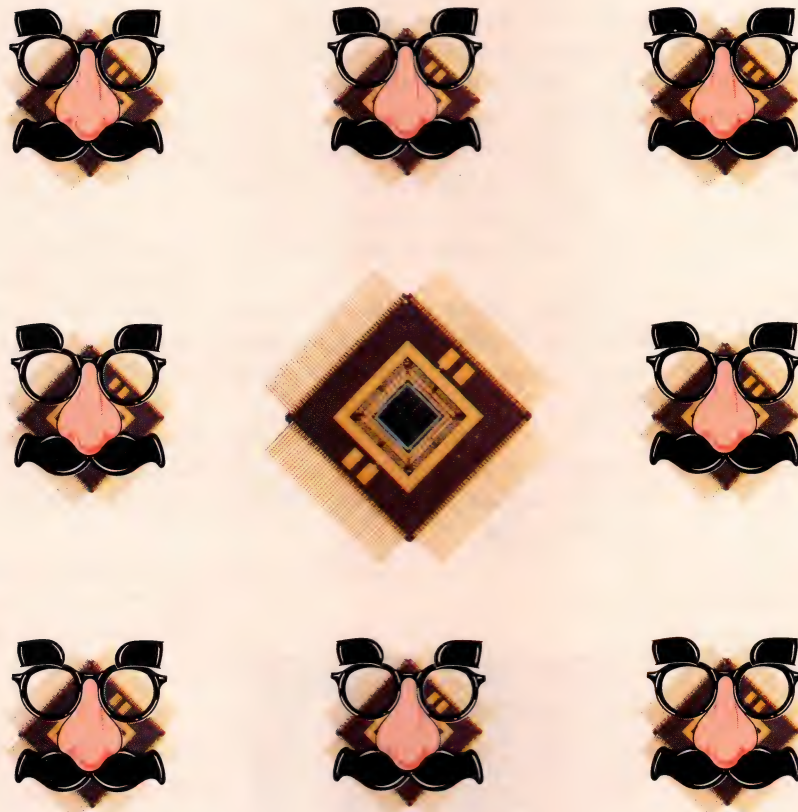
## $\mu$ Ps AND SOFTWARE

The Accel family of VLSI processors and software tools combines the software-development ease of general-purpose microprocessors with the performance of discrete, microprogrammable bit-slice components. The CPUs provide speeds of 5 MIPS and 10M flops.

The Accel Series comprises three elements. The first element, a complete software-development system, consists of high-level C, Fortran-77, and Pascal compilers, profilers, assemblers, linkers, debuggers, and simulators. The second element is a series of CMOS-processed VLSI devices that accommodate the Accel



# Not just another face in the crowd.



## 1.5 $\mu$ Military Gate Array.

The UTD family from UTMC sets itself apart from the crowd. It's attracting attention with high speed and density wrapped into a rugged gate array designed specifically for military and aerospace applications.

By specifying our UTD family, your system will stand out with performance advantages made possible by 1.25 $\mu$  effective channel length and sub-nanosecond gate delays. And you have more than 11,000 useable gates with our patented continuous-column architecture making it one of the densest 1.5 $\mu$  military arrays available.

The UTD series uses proven double-level-metal CMOS technology and is screened to selected tests in MIL-STD-883C.

This family is available for design now using UTMC's proprietary VAX<sup>TM</sup>-based HIGHLAND<sup>SM</sup> CAD system. And, we offer our design tools free of charge when you design with our gate arrays.

At UTMC, we recognize your individual needs and support them with fully-equipped design/service centers and applications experts in Boston, Los Angeles, and Colorado Springs.

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# ICs and Semiconductors

software. These processors use an architecture that's similar to a microprocessor in its high-level-language support and similar to a microprogrammed bit slice in its wide instruction word. The processors execute integer multiply/divide and floating-point add/subtract/multiply/divide operations in silicon hardware, as opposed to using micro-coded programs.

Two of the Accel processors will be available in January 1987: the \$600 (100) Model 8000-80 and the \$1000 Model 8032-80. Both have 32-bit data memories; the 8032-80, however, is a floating-point CPU that has a 64-bit code memory, vs the 8000-80's 32-bit memory. The 8000-80 is an integer-processing unit that's useful for logic simulation, AI processing, or general-purpose computing. The 8032-80 CPU provides 5-MIPS and 10M-flops single-point, floating-point processing for 3-D graphics and DSP applications. The third processor, the 8064-80 (\$1500) will be ready in June 1987. It will provide the same speed as the 8032-80 does and will perform double-precision, floating-point processing.

The third element in the Accel family is a software-development system. Based on an IBM PC/AT platform, the system has a board set that includes an Accel processor, 4M bytes of program RAM, and code and data caches. The \$10,000 system, which will be available in January 1987, includes a resident monitor and debugger to aid in software development.

**Weitek Corp, 1060 E Arques Ave, Sunnyvale, CA 94086. Phone (408) 738-8400.**

Circle No 635

## WIDEBAND AMPLIFIER

The NE5205 wideband amplifier is a 4-terminal, fixed gain, noninverting amplifier with a 3-dB bandwidth from dc to beyond 600 MHz. You can use the device with 50 or 75Ω sources and loads. The VSWR on

the input or the output is less than 1.5 over the entire 3-dB bandwidth.

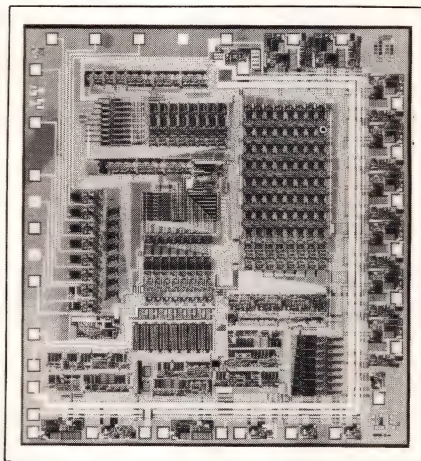
The amplifier requires no external compensation, and it operates from one 6V supply, typically drawing 25 mA of supply current. It's available in an 8-pin small-outline package for surface mounting, in a 4-lead TO-46 metal case, or in a plastic or ceramic DIP. In the TO-46 and plastic-DIP versions, the device is available for operation over military temperature ranges. The TO-46 version has a case grounding pin, which allows you to extend the upper 3-dB point to 650 MHz. \$2 (100).

**Philips Elcoma Div, Box 523, 5600 AM Eindhoven, The Netherlands. Phone (040) 757005. TLX 51573.**

Circle No 640

**Signetics Corp, 811 E Arques Ave, Sunnyvale, CA 94088. Phone (408) 991-2000.**

Circle No 641



## 8-BIT ADC

The ZN437, an 8-bit, 8-channel data-acquisition system in a 28-pin IC, comprises an 8-channel analog multiplexer, an 8-bit A/D converter, and an 8×8-bit RAM. The device has a  $\mu P$  interface, which allows you to program the system and to interrogate the results of channel conversions stored in the RAM. You can program the device to execute single-shot or continuous conversions on a selected input channel, to per-

form a single conversion on all eight channels, or to convert on all eight channels continuously.

Two versions are available; one specs a  $\pm 1/2$ -LSB linearity error, the other  $\pm 1$  LSB. The corresponding differential linearity error specs are  $\pm 3/4$  and  $\pm 1$  LSB, respectively. The multiplexer's analog inputs accept  $-0.5$  to  $+3.5$ V and have a bias current of 10 nA.

The ZN437 requires a 5V positive supply, a  $-2$  to  $-30$ V supply, and an external voltage reference between 1.5V and 3V. It typically draws 45 mA from the 5V supply. Available versions operate over commercial or military temperature ranges. £8.20 (100) for a commercial-grade,  $\pm 1$ -LSB version.

**Ferranti Electronics Ltd, Fields New Rd, Chadderton, Oldham, Lancashire OL9 8NP, UK. Phone 061-624 0515. TLX 668038.**

Circle No 636

**Ferranti Electric Inc, 87 Modular Ave, Commack, NY 11725. Phone (516) 543-0200.**

Circle No 637

## SOS GATE ARRAYS

Targeted for applications requiring enhanced radiation hardness, MA9000 Series gate arrays are fabricated using HSOS-III, a 3- $\mu$ m SOS technology. To ease routing, the arrays feature two levels of metallization with an 8- $\mu$ m metal pitch. Versions are available with either 2500 or 4000 gates and as many as 102 bond pads. The typical gate delay is 1.7 nsec, and the typical toggle-frequency capability of flip-flops is 50 MHz. Power dissipation amounts to 2  $\mu$ W/gate/MHz.

The gate arrays can withstand a total radiation dose of greater than  $10^6$  rad and an upset dose-rate radiation level of greater than  $10^{10}$  rad/sec. Single-event upsets amount to soft errors of about  $1.9 \times 10^{-9}$  errors/bit/day, and the arrays withstand neutron densities in excess of  $10^{15}$  neutrons/cm<sup>2</sup>.

A 2500-gate device in an 84-pin



# ICs and Semiconductors

pin-grid array costs approximately £120 for a commercial-grade part or £230 (100) for a military-grade part.

**Marconi Electronic Devices Ltd,  
Lincoln Industrial Park, Dodding-  
ton Rd, Lincoln LN6 3LF, UK.  
Phone (0522) 688121. TLX 56380.**

**Circle No 642**

**Marconi Electronic Devices Inc,  
80 Smith St, East Farmingdale,  
NY 11735. Phone (516) 756-1900.**

**Circle No 643**

## DRIVER IC

The IP3D10 is a 4A driver suitable for driving stepper motors or other inductive loads from supplies as high as 50V. It has an H-bridge output stage, which includes integral voltage-spike-suppression diodes. TTL-compatible control inputs with a separate ground return pin improve noise immunity and allow operation from TTL elements in split-supply applications. A separate  $V_{CC}$  supply pin allows you to operate the driver's control logic from a 5V supply to reduce power consumption. Other features of the driver include internal thermal overload and crossover-current protection.

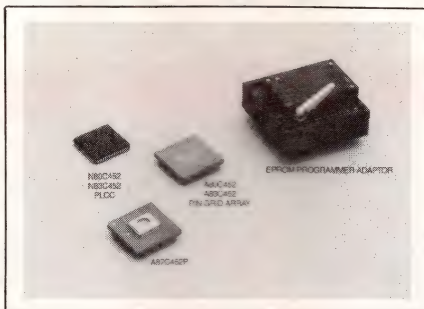
The device is specified over the full operating temperature range of 0 to 70°C, and it has a fully specified reverse-bias safe operating area. It comes in a power SIP. IP1D10 and IP2D10 versions, with operating temperature ranges of -55 to +125°C and -25 to +85°, respectively, are under development, with planned versions capable of switching 80V loads. £3.50 (50,000).

**Integrated Power Semiconductors Ltd, MacIntosh Rd, Kirkton Campus, Livingston EH54 7BW, UK. Phone (0506) 416416. TLX 727360.**

**Circle No 644**

**Integrated Power Semiconduc-**  
**tors, 2727 Walsh Ave, Suite 201,**  
**Santa Clara, CA 95051. Phone**  
**(408) 727-2772.**

**Circle No 645**



## I/O PROCESSOR

The UPI-452 programmable I/O processor acts as an interface between a high-speed  $\mu$ P and slower computer peripherals or data-communication devices. The VLSI component incorporates a buffer that lets the host processor communicate with peripherals in bursts of data rather than a byte at a time.

On a single chip, the I/O processor combines a 128-byte, 2-channel bidirectional FIFO buffer; a 2-channel DMA processor; an 8k-byte EPROM; 256 bytes of RAM; and an MCS-51 microcontroller with 40 programmable I/O lines.

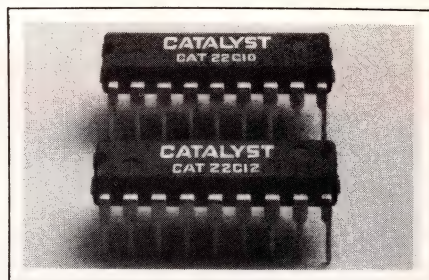
The on-chip FIFO buffer provides asynchronous, bidirectional transfers over its slave interface at speeds as great as 2.5M bytes/sec. For maximum decoupling of the interface, you can program the size and threshold of each of the two FIFO channels. The buffer supports three slave-bus-interface handshaking methods: DMA, interrupt, and polled. The EPROM and ROM-less versions of the UPI-452 are available now in 68-lead pin-grid arrays (PGAs). EPROM versions, \$70 (1000); ROM-less versions, \$30 (1000).

**Intel Corp, Department W-319,  
3065 Bowers Ave, Santa Clara, CA  
95051. Phone (916) 351-5173.**

**Circle No 522**

## NOVRAMs

The CAT22C12 1024-bit CMOS static RAM is organized as 256×4 bits and limits current to 50 mA active and 30  $\mu$ A standby. The CAT22C10, a 256-bit static RAM, organized as 64×4 bits, features 40-mA active



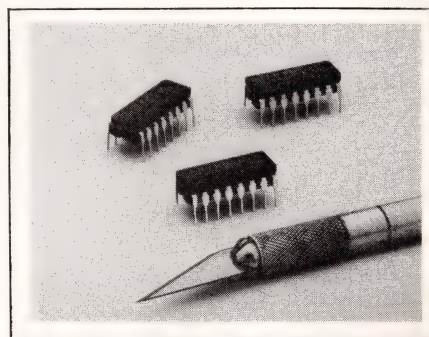
current and 30- $\mu$ A standby current.

Both devices contain internal EEPROM arrays that provide bit-by-bit backup for the RAM arrays. The parts can retain data for more than 10 years, and they can perform more than 10,000 store cycles, the manufacturer claims. The RAMs can support unlimited recall, read, and write operations.

The RAMs also contain internal false-RAMs-protection circuitry, which prevents any store operation from occurring when  $V_{CC}$  is less than 3.5V. Other internal circuitry performs an automatic recall operation on power-up. Both devices are TTL compatible and come in 18-pin JEDEC - approved packages. CAT22C12 (200-nsec version), \$14.87; CAT22C10, \$5.65 (100).

**Catalyst Semiconductor Inc,**  
4051 Burton Dr, Santa Clara, CA  
95054. Phone (408) 980-9144.

**Circle No 523**



## CONTROL ICs

The SG1846/1847 control ICs are pin-for-pin replacements for the UC1846/47 line. The manufacturer claims that the devices improve line and load regulation over those of the UC1846/47 parts. The ICs feature automatic feed-forward compensation and programmable pulse-cur-

Continued on pg 174



# The fine art of





# CMOS packaging.

## Now you can get RCA world-class CMOS chips in your choice of surface mounted packages.

For increased board density, lower lead inductances (for increased speed) or lower manufacturing costs, consider surface mounting. RCA offers a broad range of CMOS ASICs and standard ICs in three different families of surface-mount packages.

### **Small-outline (SO) packages.**

Except for the "gull-wings" that make it surface-mountable, the SO package is like a miniature DIP. A major advantage of the SO package is its small footprint (50-mil lead centers vs. the 100-mil lead centers of a DIP.)

RCA offers two SO body widths: 150-mil for 8, 14 or 16 leads; and 300-mil for 16, 20, 24 or 28 leads. Both meet JEDEC standards.

### **Plastic chip-carriers (PCC).**

For well-protected leads and a minimum-sized package, RCA offers the square PCC with "J-bend" leads on all four sides. Initial PCC's offer lead counts of 28, 44, 68 and 84.

All RCA PCC package dimensions conform to JEDEC standards.

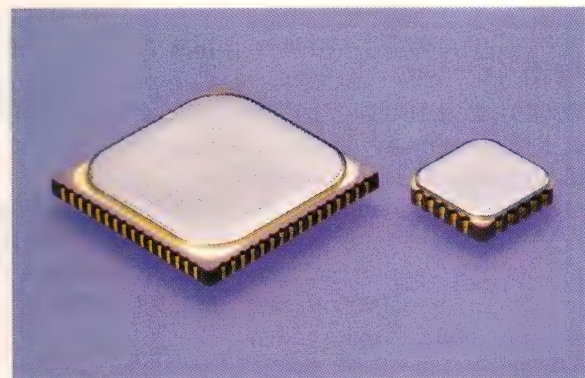
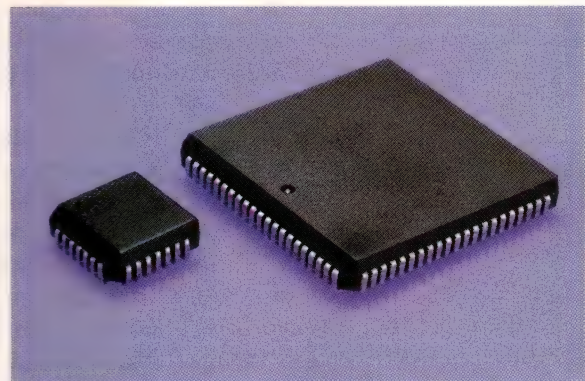
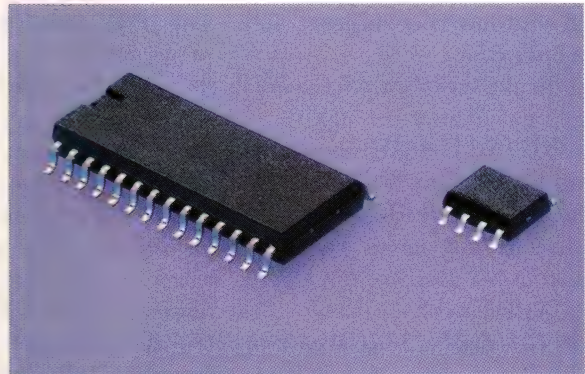
### **Ceramic leadless-chip-carriers.**

For applications requiring the highest reliability, these packages are screened to MIL-STD-883, Method 5004 Classes S and B format.

RCA leadless-chip carriers are hermetically sealed, square, three-layer ceramic. They're available with terminals spaced on 40-mil centers (24, 32 or 64 terminals) or 50-mil centers (20, 28 or 44 terminals).

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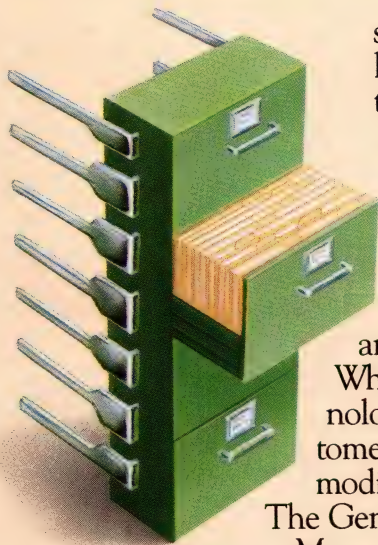
# RCA



## EDN December 11, 1986



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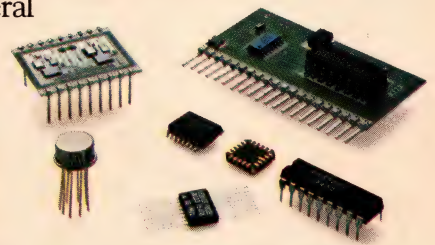
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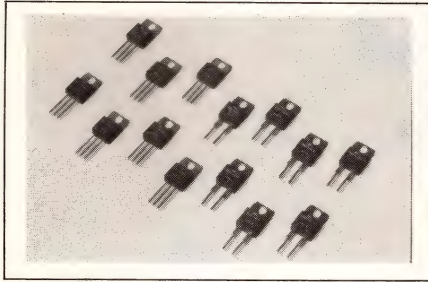


# ICs and Semiconductors

DIP. The microprocessor operates at 3.5 to 12 MHz from a  $5V \pm 10\%$  power supply. A military version of the 685C31 costs \$1100 (100).

**Electronic Designs Inc, 35 South St, Hopkinton, MA 01748. Phone (617) 435-9077. TLX 948004.**

Circle No 529



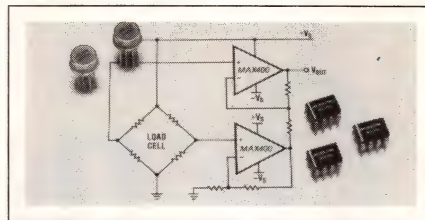
## DIODES

The DSK16 fast-recovery diodes each consist of two diodes with a common cathode in a TO-220 package. These chips are fabricated with a glass-passivation process. The di-

odes, which are intended for use in switching power supplies, are rated at an average of 9A per diode at 50 to 200V, and they recover in 50 nsec. They cost \$1.20 to \$1.85, depending on voltage and quantity. Delivery, six weeks ARO.

**Brown Boveri Power Semiconductors, RMC Power Semiconductor Div, 2150 W 6th Ave, Broomfield, CO 80020. Phone (303) 469-1883. TLX 299745.**

Circle No 530



## LOW-OFFSET OP AMP

The MAX-400 bipolar op amp has the lowest offset voltage available in

a non-chopper-stabilized op amp, the manufacturer claims. The op amp's maximum offset voltage is 10  $\mu V$  at 25°C. The MAX-400 also offers a guaranteed maximum offset voltage drift of 0.3  $\mu V/^\circ C$ . The part's open-loop gain is 500,000 min, and its CMRR is 114 dB. Its operating voltage is  $\pm 3$  to  $\pm 18V$ .

The MAX-400 comes in an 8-pin plastic or ceramic DIP and an 8-pin TO-99 package. In a plastic DIP, the part comes only in the commercial grade. In the ceramic DIP and the TO-99 package, the part is available for use over the commercial (0 to 70°C), industrial (-40 to +85°C) and military (-55 to +125°C) temperature ranges. The plastic-DIP version costs \$6; the military TO-99 version sells for \$17.40.

**Maxim Integrated Products, 510 N Pastoria Ave, Sunnyvale, CA 94086. Phone (408) 737-7600.**

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## OUR NEW NOISE-FREE SCSI CHIP IS MAKING A LOT OF NOISE.

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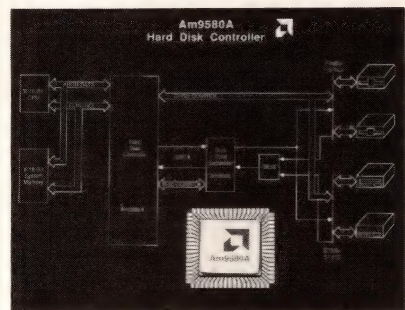
To get complete information on the D Series and many other image sensing products we have to offer— for non-contact inspection, page and character scanning, robotics, or spectroscopy – contact EG&G Reticon.



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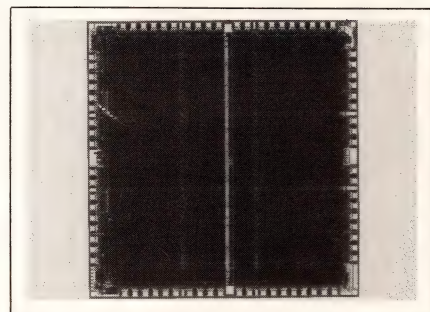
### DISK CONTROLLER

The Am9580A hard-disk controller features on-chip dual-sector buffers, a DMA controller, and a 16-bit CPU. The controller's 15M-bit/sec serial-data-transfer rate and dual-sector buffers allow no sector interleaving, which reduces file-access time. The sector buffers are programmable for sector sizes of 128, 256, and 512 bytes.

The device features several error-detection and -correction schemes, including the Reed-Solomon algorithm. According to the manufacturer, the Am9580A is the first available device in a chip set that also includes the Am9582 disk-data separator. The part is suitable for use with a range of disk interfaces, including the ST506 and ST412. The 9580A costs \$63 (100) and comes in a 68-lead LCC.

**Advanced Micro Devices Inc.,  
Box 3453, Sunnyvale, CA 94088.  
Phone (408) 732-2400.**

Circle No 532



### LOGIC ARRAY

The XC2018-70 1800-gate logic-cell array features 1800 gates and 70-MHz operation. The devices, which are fabricated with CMOS static-cell technology, are sup-



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CS-3221	Spindle Motor Controller
CS-4002	Burst Servo Controller

## Floppy Disk

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CS-3470A	Read Amplifier System
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CHERRY SEMICONDUCTOR CORPORATION 2000 South County Trail, East Greenwich, RI 02818 (401) 885-3600  
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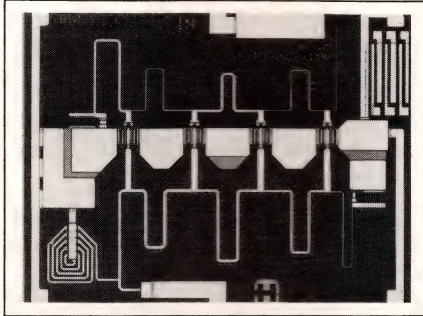
# ICs and Semiconductors

ported by the company's Xact development system and Xactor real-time in-circuit emulator.

As with previous devices in this line, the XC2018-70 comprises three types of configurable elements: I/O blocks, logic blocks, and interconnection paths. You can configure the final arrangement of all these blocks. \$69.25 (100).

**Xilinx, 2069 E Hamilton Ave, San Jose, CA 95125. Phone (408) 559-7778.**

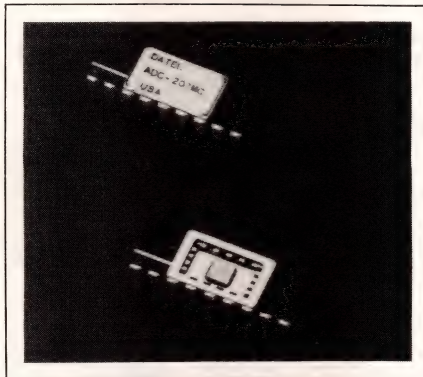
Circle No 533



signal gain of 5 dB with 0.75-dB variation across the 6- to 18-GHz frequency band. Its maximum input and output VSWR is 2:1; its noise spec at 50 mA is 6 dB typ at 18 GHz. Less than \$200 (100). Delivery, six weeks ARO.

**Harris Microwave Semiconductor, 1530 McCarthy Blvd, Milpitas, CA 95035. Phone (408) 262-2222.**

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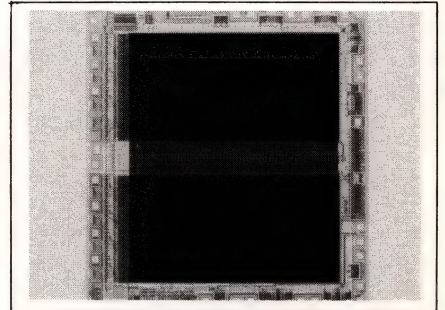


## FLASH CONVERTER

The ADC-207, a 7-bit flash A/D converter, is fabricated with the company's 1.2- $\mu$ m AVLSI process. The process, which yields small geometries, keeps the converter's parasitic capacitance to a minimum, so resistors are close together for better temperature tracking. The device can convert at more than 20 MHz. It operates from a single 5V supply and consumes 250 mW. Its linearity is  $\frac{1}{2}$  LSB. To achieve linearity of greater than 7 bits, you can tie the part's midpoint reference tap to an external source. The A/D converter also provides 3-state outputs. Models that operate over 0 to 70°C cost \$30; versions specified for operation over -55 to +125°C sell for \$59 (100).

**GE/Datel, 11 Cabot Blvd, Mansfield, MA, 02048. Phone (617) 339-9341. TLX 951340.**

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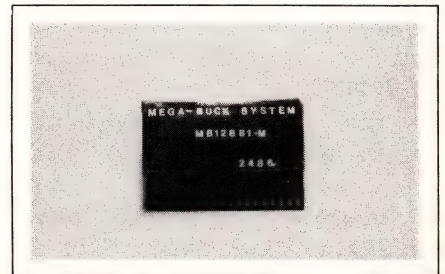


## UV-EPROM

The NMC27C512 high-speed, 512k-bit UV-EPROM is configured as 64k $\times$ 8 bits and is pin compatible with its NMOS counterparts. Versions having 250-, 300-, and 350-nsec access times operate from one 5V $\pm$ 10% power supply. The 200-nsec version of the part operates from a 5V $\pm$ 5% power supply. The NM27C512 consumes 55 mW in active mode, and it comes in a 28-pin ceramic DIP. From \$25 to \$30 (100) for a commercial-grade device (0 to 70°C), depending upon speed.

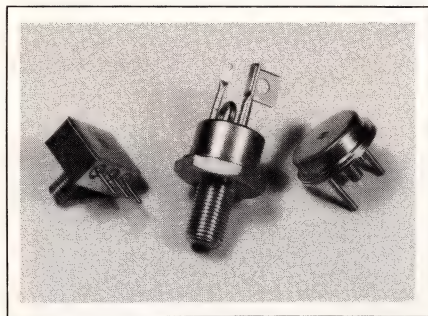
**National Semiconductor Corp, 2900 Semiconductor Dr, Santa Clara, CA 95052. Phone (408) 721-4407.**

Circle No 536



## MEMORY MODULE

The MB12881-M single-in-line memory module (SIMM) comprises four surface-mounted, 256k-bit static RAMs on a 2-in<sup>2</sup> pc board. The SIMM also provides onboard decoding and decoupling. The module is available in versions having access times of 100, 120, and 150 nsec. It



## TRANSISTORS

The SDT 99501-04, STD 99901-04, and STD 99701 are high-voltage, high-current planar power transistors that come in TO-68, TO-114 and TO-228/AC packages, respectively. The chips feature single-chip planar construction. They have low saturation voltages ( $V_{CE}$  is 1.0V typ) and dissipate as much as 700W. The devices spec an  $h_{FE}$  of 10 min at 60 to 200A. SDT 99501-04, from \$125; STD 99901-04, from \$135; STD 99701, from \$158.

**Solitron Devices Inc, 1177 Blue Heron Blvd, Riviera Beach, FL 33404. Phone (305) 848-4311. TLX 513435.**

Circle No 534

## GaAs AMPLIFIER

The HMM-11810-0 monolithic microwave IC (MMIC) employs a standard 0.5- $\mu$ m GaAs process to achieve operation in the 6- to 18-GHz frequency band. The chip is available in die form, so you can place gain anywhere in a system in small blocks. The device has a small-

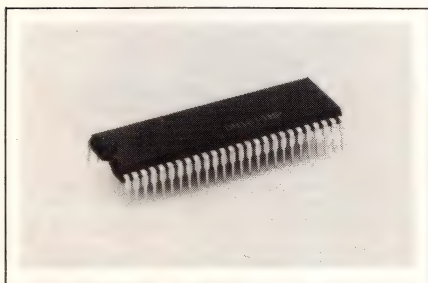


# ICs and Semiconductors

consumes 40 mW while operating at 1 MHz and uses 10  $\mu$ W in standby mode. All the module's inputs and outputs are TTL compatible. \$235 (100).

**Aeries Electronics & Co, 478 Hamilton Ave, Suite 184, Campbell, CA 95008. Phone (408) 866-6391.**

Circle No 540



## TRANSCEIVER

The DN1811MP, a CMOS multiplexer/demultiplexer housed in a 52-pin shrink DIP, offers 16 parallel inputs and one serial output or one serial input and 16 parallel outputs. The device generates transmitting packets and provides Manchester coding and decoding as well as error checking. The IC operates from a 5V supply. Its clock frequency is 0 to 20 MHz, and its oscillation frequency is 10 MHz. The device has a transmission rate of 1.25M bps and a cyclic transfer time of 33  $\mu$ sec; it also features 3-bit CRC error checking. \$47.

**Diaguide Inc, 2 Executive Dr, Fort Lee, NJ 07024. Phone (201) 461-3116.**

Circle No 538

**Dainichi-Nippon Cables Ltd, New Kokusai Bldg, 3-4-1, Marunouchi, Chiyodaku, Tokyo 100, Japan. Phone Tokyo (03) 216-1551.**

Circle No 539

## FET

The SMM70N05 GhostFET offers 18-m $\Omega$  on-resistance and a continuous current rating of 70A max. The technology used to manufacture this device provides a chip density of 1.6

million transistors/in<sup>2</sup>. The device is available in TO-204 or TO-3 packages and costs \$10.11 (1000). Samples are available from stock; production quantities are available from stock to 10 weeks ARO.

**Siliconix Inc, 2201 Laurelwood Rd, Santa Clara, CA 95054. Phone (408) 970-5597.**

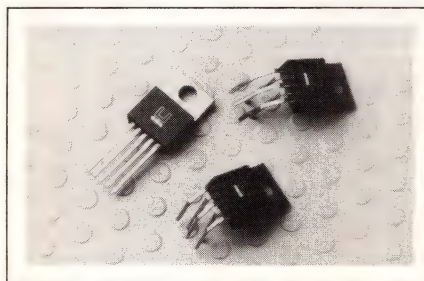
Circle No 541

## STATIC RAMs

This family of four 4k-bit static RAMs uses the company's Self Aligned Bipolar CMOS (SABiC II) fabrication technology. The four devices are pin and performance compatible with equivalent bipolar ECL RAMs but exhibit a 15% reduction in power consumption over that of the bipolar ECL devices, the manufacturer claims. Models that offer 15-nsec access times and come in various bit- and nibble-wide configurations cost from \$14.55 to \$19.55 (1000).

**Saratoga Semiconductor, 10500 Ridgeview Ct, Cupertino, CA 95014. Phone (408) 973-0945.**

Circle No 542



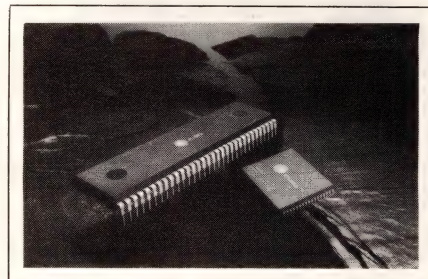
## BIPOLAR SWITCH

When it's activated by logic-level signals, the UC2950 monolithic IC provides high-current switching with low saturation voltages. You can activate the IC's source and sink switches independently without concern for timing, because a built-in interlock keeps the sink off when the source is on. The device has two TTL inputs and a half-bridge, 3-state output capable of 4A pk and 2A continuous operation. The part's supply-voltage range is 8 to 35V.

The UC2950 has the high current capability necessary for driving large capacitive loads with fast rise and fall times. With its internal fly-back diodes, it's suitable for driving inductive loads as well. You can use two UC2950s together to form a full-bridge, bipolar motor driver for use in high-frequency, chopper current motor control. Three UC2950s can drive 3-phase brushless dc motors. The devices come in TO-220 packages and cost \$2.75 (100).

**Unitrode Integrated Circuits Corp, 7 Continental Blvd, Merrimack, NH 03054. Phone (603) 424-2410.**

Circle No 543



## DUAL-PORT RAM

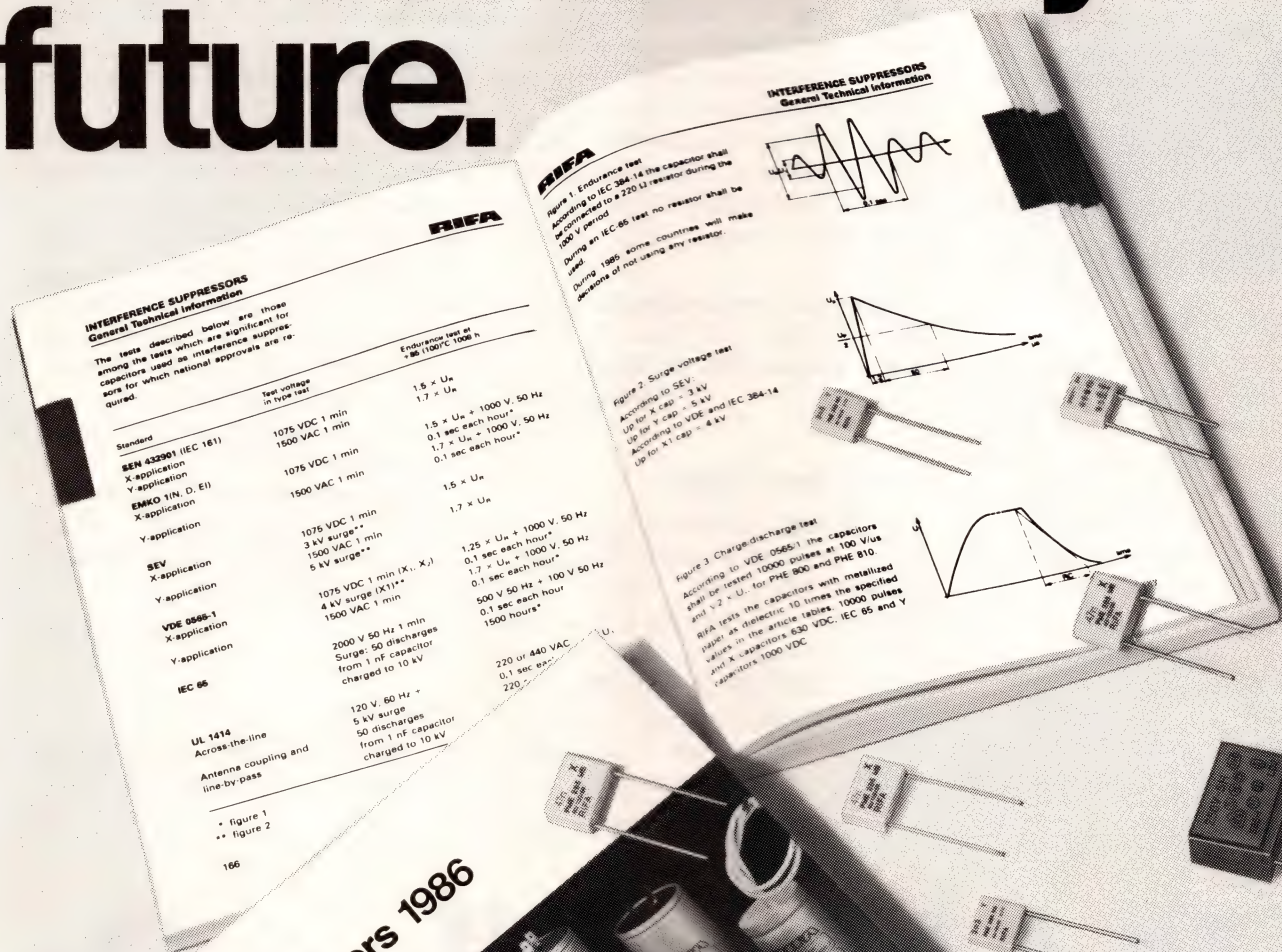
The VT16DP8, a 16k-bit dual-port CMOS RAM, provides a single-chip solution to the problem of transferring data between systems of dissimilar word size. The device's two separate I/O ports allow simultaneous, independent access by both 8-bit and 16-bit microprocessors. The left side of the RAM is organized as 1024 16-bit words. This port is controlled by two separate enable lines, one for the upper eight bits and one for the lower eight bits. The right port is organized as 2048 8-bit words. At this port, the user can access either the upper or the lower 8 bits of a 16-bit word. The devices feature a 60-nsec access time and draw 60 mA. They're available in 64-pin DIPs and 68-pin PLCCs. \$52.60 (1000).

**VLSI Technology Inc, Application Specific Memory Products Div, 1109 McKay Dr, San Jose, CA 95131. Phone (408) 434-3000.**

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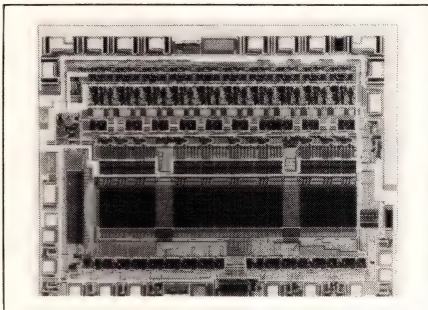
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# ICs and Semiconductors



## ERASABLE PLD

The PALC22V10 is an erasable, re-programmable CMOS version of the 22V10 programmable logic device. The commercial version offers 33-MHz operation and draws 90 mA active current. If all inputs are either above 3.485V or below 0.4V, the current requirement drops to 55 mA. You can develop code for these devices by using standard 22V10 CUPL or Abel systems.

PALC22V10s are available in 24-pin plastic, ceramic, or windowed ceramic DIPs for operation over 0 to

70°C. They also come in 24-pin ceramic and windowed ceramic DIPs and JEDEC-standard 28-pin square LCCs for operation over -55 to +125°C. Prices range from \$11.95 (100) for 35-nsec, commercial-grade devices in plastic DIPs to \$96.55 (100) for 25-nsec military-grade devices.

**Cypress Semiconductor Corp.,**  
3901 N First St, San Jose, CA  
95134. Phone (408) 943-2666.

Circle No 544

## CMOS DSP CHIP

The TMS320C10-25 is a higher-performance version of the company's TMS320C10 DSP chip. The TMS320C10-25 is also a pin- and software-compatible CMOS version of the TMS32010 NMOS DSP chip. Its typical current drain is 35 mA, which is 1/3 the drain of its NMOS counterpart. At its maximum clock

rate, 25.6 MHz, the TMS320C10-25 can execute 6.4 MIPS.

Although the part is optimized for DSP applications, this 16/32-bit  $\mu$ P can also support a range of computation-intensive applications, because its instruction set has general-purpose instructions as well as DSP instructions. The device features a 160-nsec instruction-cycle time, a 144-word data RAM, a 0- to 16-bit barrel shifter, and a 16-bit-wide 50M-bit/sec data bus. The part is available in a 40-pin plastic DIP and costs \$60 (100).

**Texas Instruments Inc, Semiconductor Group (SC-637),**  
Box 809066, Dallas, TX 75380. Phone  
(800) 232-3200, ext 700.

Circle No 548

## EEPROM

The 48128 EEPROM, organized as 16k $\times$ 8 bits, is the first in a family of

# SRAMs. The By

Whether your need is 8Kx8, 128Kx8 or in between, EDI can supply JEDEC, Full-CMOS EDI, the pioneer in space-saving memory module technology, offers the fastest (to 20ns) Cost conscious? 32Kx8 and 128Kx8 modules are available in plastic SOP packages for

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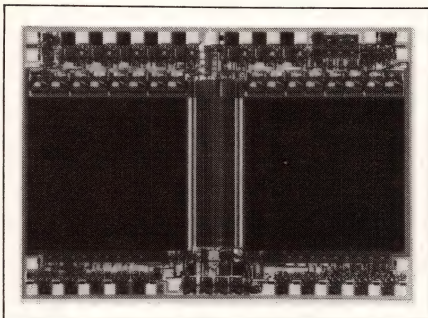
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Electronic Designs Inc., 35 South Street, Hopkinton, MA 01748, USA, Telephone (617) 435-9077, TELEX 948004

Electronic Designs Europe, Shelley House, The Avenue, Lightwater, Surrey GU18 5RF, U.K., Telephone 0276 72637, TELEX 858325



# ICs and Semiconductors



devices based on the company's proprietary single-transistor cell design. This cell design permits the manufacturer to build EEPROMs with a standard EPROM process and with a die size equal to that of an EPROM. The 48128's pinout is the same as that of the 27128 EPROM.

The 48128 can be erased in 20 sec; it takes 2 msec to write one byte to the chip. The part's access time is 200 nsec. The chip requires a  $5V \pm 10\%$  supply for operation and a 21V supply for programming. It can

endure 100 erasure/programming cycles, and it can retain data for 10 years. Commercial-grade parts in ceramic DIPs sell for \$8.30 (100). The company plans to offer the part in a plastic DIP and a PLCC in 1987.

**Seeq Technology Inc., 1849 Fortune Dr., San Jose, CA 95131. Phone (408) 942-1990. TLX 296609.**

**Circle No 546**

## OP AMP

The CMOS TS911 autozeroed operational amplifier is the first complete chopper-stabilized monolithic op amp, the company claims. The part requires no external storage capacitors for offset compensation. The TS911 has a  $15\text{-}\mu\text{V}$  max offset-voltage specification and a  $0.15\text{-}\mu\text{V}/^\circ\text{C}$  max offset-voltage temperature coefficient. It operates from single 4.5 to 16V supplies and draws  $350\text{ }\mu\text{A}$  typ. The part can also operate from

dual supplies; its total supply voltage is 18V max.

The op amp's open-loop voltage gain is 115 dB min when it operates with a  $10\text{-k}\Omega$  load. Its unity-gain bandwidth is 1.5 MHz, and its slew rate is  $2.5\text{V}/\mu\text{sec}$ . It has a common-mode rejection ratio of 110 dB, and the input common-mode range extends from 2V below the positive supply to the negative supply. The TSC911 is available in 8-pin plastic or ceramic DIPs. From \$2.10 (100).

**Teledyne Semiconductor, 1300 Terra Bella Ave., Mountain View, CA 94039. Phone (415) 968-9241. TWX 910-379-6494.**

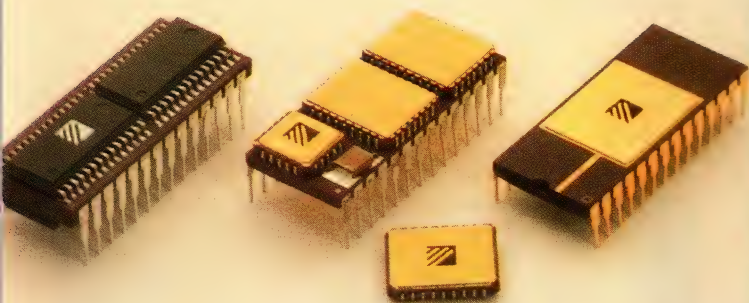
**Circle No 551**

## STATIC RAMs

The IDT7130 and IDT7132 dual-port static RAMs have access times of 55 nsec at 0 to  $70^\circ\text{C}$ . The RAMs are master devices; that is, they

# tewide Bunch.

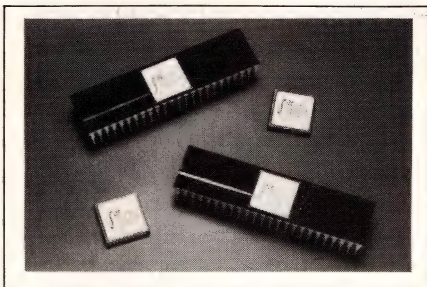
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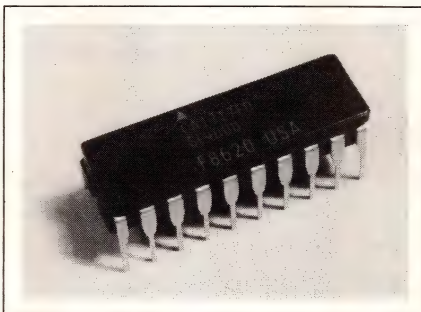
contain all the arbitration logic necessary to detect simultaneous access of a memory location from both ports. The corresponding slave devices, the IDT7140 and IDT7142, interface directly to the master devices, so you don't need additional arbitration logic when you expand the data paths to 16 bits.

The IDT7130 and -40 are organized as 1k×8 bits; the IDT7132 and -42 are 2k×8-bit devices. Typical power dissipation for all standard devices is 325 mW (5 mW standby). Prices begin at \$13.38 for the IDT7130 and -40 and \$20 for the

IDT7132 and -42 (100).

**Integrated Device Technology Inc., 3236 Scott Blvd, Santa Clara, CA 95054. Phone (408) 727-6116. TWX 910-338-2070.**

Circle No 547



## INTERFACE

The SL4000 is a CMOS chip for StarLAN applications. The chip is a Manchester encoder with a digital phase-locked loop and on-chip collision-detection capability. It is designed for the 1M-bit/sec LAN pro-

tolocol specified in the IEEE 802.3 draft.

The SL4000 provides a complete interface for existing network controllers, such as Intel's 82586, National's DP8390, and Rockwell's R68802, in a station-controller design. The device can also be used in StarLAN hub design for carrier sensing, collision detection, and jitter removal. Samples of the SL4000 are currently available in 20-pin ceramic DIPs. Delivery of production quantities is eight weeks ARO. \$15 (100).

**Semicustom Logic Inc., 50 Airport Parkway #64, San Jose, CA 95110. Phone (408) 279-4441.**

Circle No 549

## TRANSISTORS

The BSR19/19A and PMBT5550/51 npn high-voltage transistors spec  $V_{CE0S}$  of 140 and 160V. Their npn

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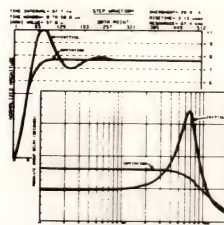
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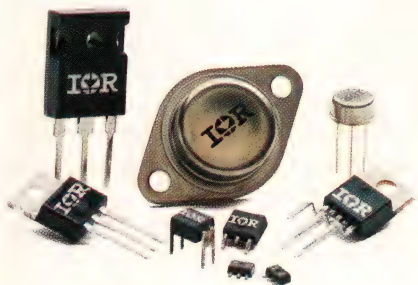
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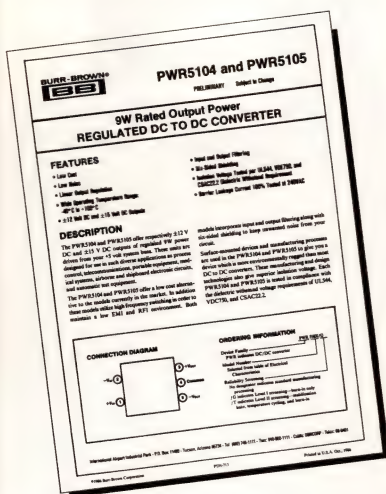
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## ICs and Semiconductors

complements, the BSR20/20A and PMBT5400/01, have  $V_{CEOS}$  of 120 and 150V. The transistors are suitable for use in general-purpose amplification and switching applications. You can place them on hybrids or pc boards, and they're available in bulk form or on 8-mm tape for use with automatic pick-and-place machines. The devices sell for \$0.75 (OEM qty).

**Amperex Electronic Corp., George Washington Hwy, Smithfield, RI 02917. Phone (401) 232-0500.**

Circle No 552

### 64k-BIT PROM

The 93Z667 64k-bit PROM comes in a 300-mil DIP and offers performance matching that of 16k-bit PROMs in 300-mil DIPs, according to the manufacturer. The 64k-bit part is a drop-in-compatible upgrade for the company's 16k-bit, 300-mil PROMs.

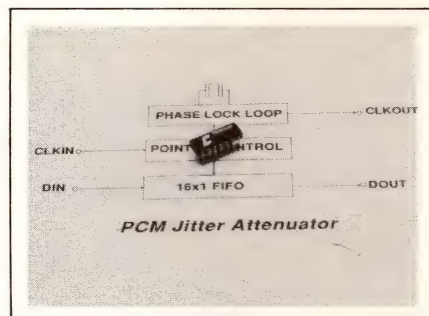
The 93Z667 TTL bipolar PROM is organized as  $8k \times 8$  bits. The commercial grade offers an access time of 40 nsec; the military version specs 45 nsec. The device has 3-state outputs that provide active pullups when enabled and high output impedance when disabled, so they allow for the optimization of word expansion in bus-oriented systems. In a 300-mil sidebraced ceramic DIP, a commercial-grade 93Z667 costs \$57.15 (100). The part is also available in a 600-mil DIP for \$50 (100).

**Fairchild Semiconductor, Memory and High Speed Logic Div., 1111 39th Ave SE, Puyallup, WA 98373. Phone (800) 554-4443.**

Circle No 550

### JITTER ATTENUATOR

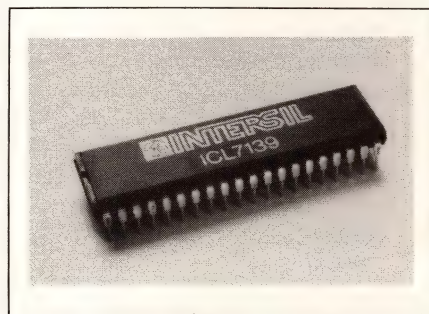
The CS61600 analog jitter attenuator can eliminate the phase jitter that accumulates between points on a T1 transmission line. The device removes distortion in T1 applications such as carrier and switching



systems, local-area-network gateways, and multiplexers. The CS61600, which is housed in a 14-pin DIP, operates from one 5V supply. \$4 (1000).

**Crystal Semiconductor Corp., 2024 E Saint Elmo Rd, Austin, TX 78760. Phone (512) 445-7222.**

Circle No 554



### 3 1/4-DIGIT DMM

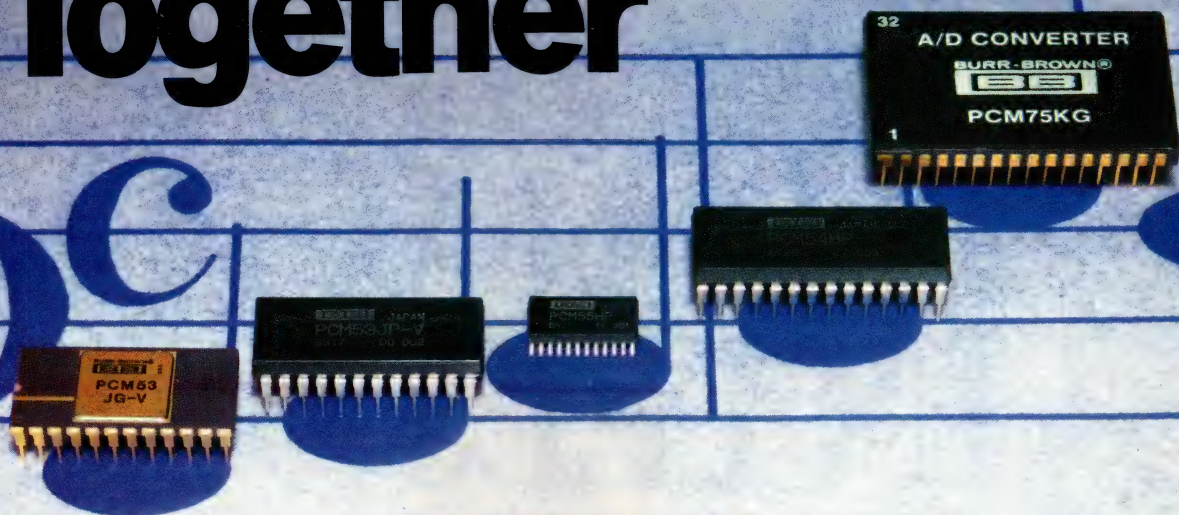
The ICL7139 40-pin DMM IC is compatible with a duplex LCD. It automatically selects the appropriate magnitude range for the parameter being measured and activates the appropriate LCD drivers to display the result. The unit can auto-range among four ranges each of dc voltage, dc current, ac voltage, and resistance (from 4 k $\Omega$  to 4 M $\Omega$ ). The 7139 comes in a 40-pin plastic DIP and costs \$13.50 (100).

**GE/Intersil, 10600 Ridgeview Ct, Cupertino, CA 95014. Phone (408) 996-5000.**

Circle No 553



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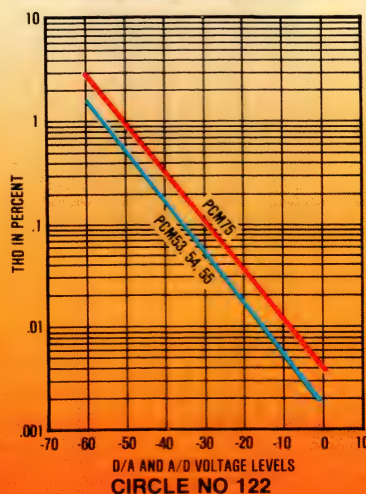
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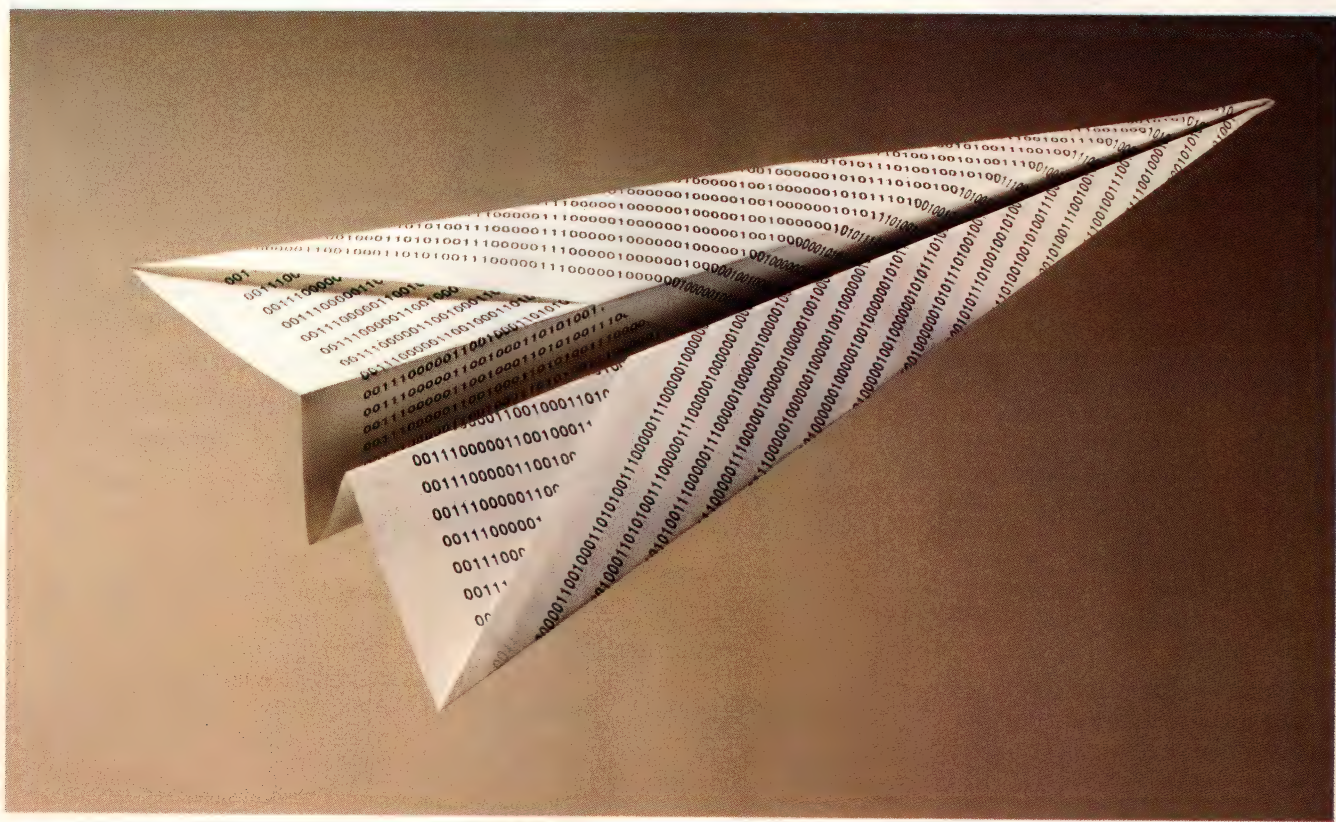


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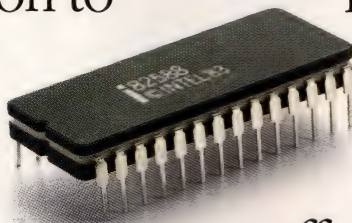
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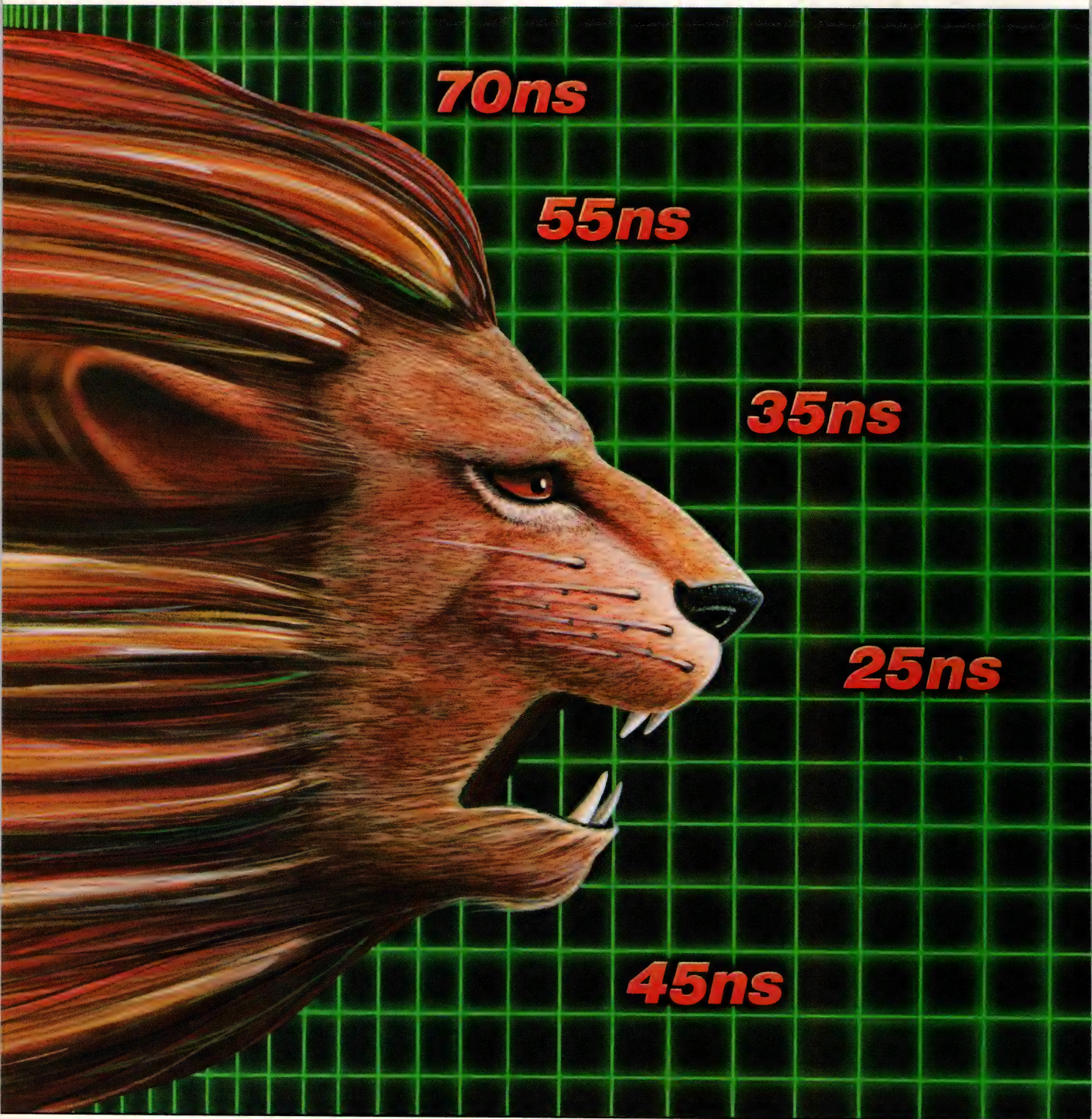


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TMM2068D	4KX4	45	20P CDIP	NOW	NOW	
TMM2068D	4KX4	35	20P CDIP	NOW	NOW	
TMM2068AD	4KX4	25	20P CDIP	9/86	11/86	
TMM2078D	4KX4	55	22P CDIP	NOW	NOW	
TMM2078D	4KX4	45	22P CDIP	NOW	NOW	
TMM2078D	4KX4	35	22P CDIP	NOW	NOW	
TMM2078AD	4KX4	25	22P CDIP	9/86	11/86	
TMM2018D	2KX8	55	24P CDIP	NOW	NOW	
TMM2018D	2KX8	45	24P CDIP	NOW	NOW	
TMM2018D	2KX8	35	24P CDIP	NOW	NOW	
TMM2018AD	2KX8	25	24P CDIP	12/86	12/86	
TMM2089C	8KX9	45	28P SBDIP	NOW	10/86	
TMM2089C	8KX9	35	28P SBDIP	NOW	10/86	
TMM2088P	8KX8	45	28P DIP	9/86	12/86	
TMM2088P	8KX8	35	28P DIP	9/86	12/86	
TC55416P	16KX4	45	22P DIP	11/86	2/87	
TC55416P	16KX4	35	22P DIP	11/86	2/87	
TC55416P	16KX4	25	22P DIP	UNDER DEVELOPMENT		
TC55417P	16KX4	45	24P DIP	11/86	2/87	
TC55417P	16KX4	35	24P DIP	11/86	2/87	
TC55417P	16KX4	25	24P DIP	UNDER DEVELOPMENT		
TC5561P	64KX1	70	22P DIP	NOW	NOW	
TC5561P	64KX1	55	22P DIP	NOW	NOW	
TC5562P	64KX1	55	22P DIP	NOW	NOW	
TC5562P	64KX1	45	22P DIP	NOW	NOW	
NOTE: DIP = PLASTIC CDIP = CERDIP SBDIP = SIDE BRAZED CERAMIC						

NOTE: DIP = PLASTIC CDIP = CERDIP SBDIP = SIDE BRAZED CERAMIC

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Language Directed Editors

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Language Development Systems

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## Documentation

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## Software Design and Specify

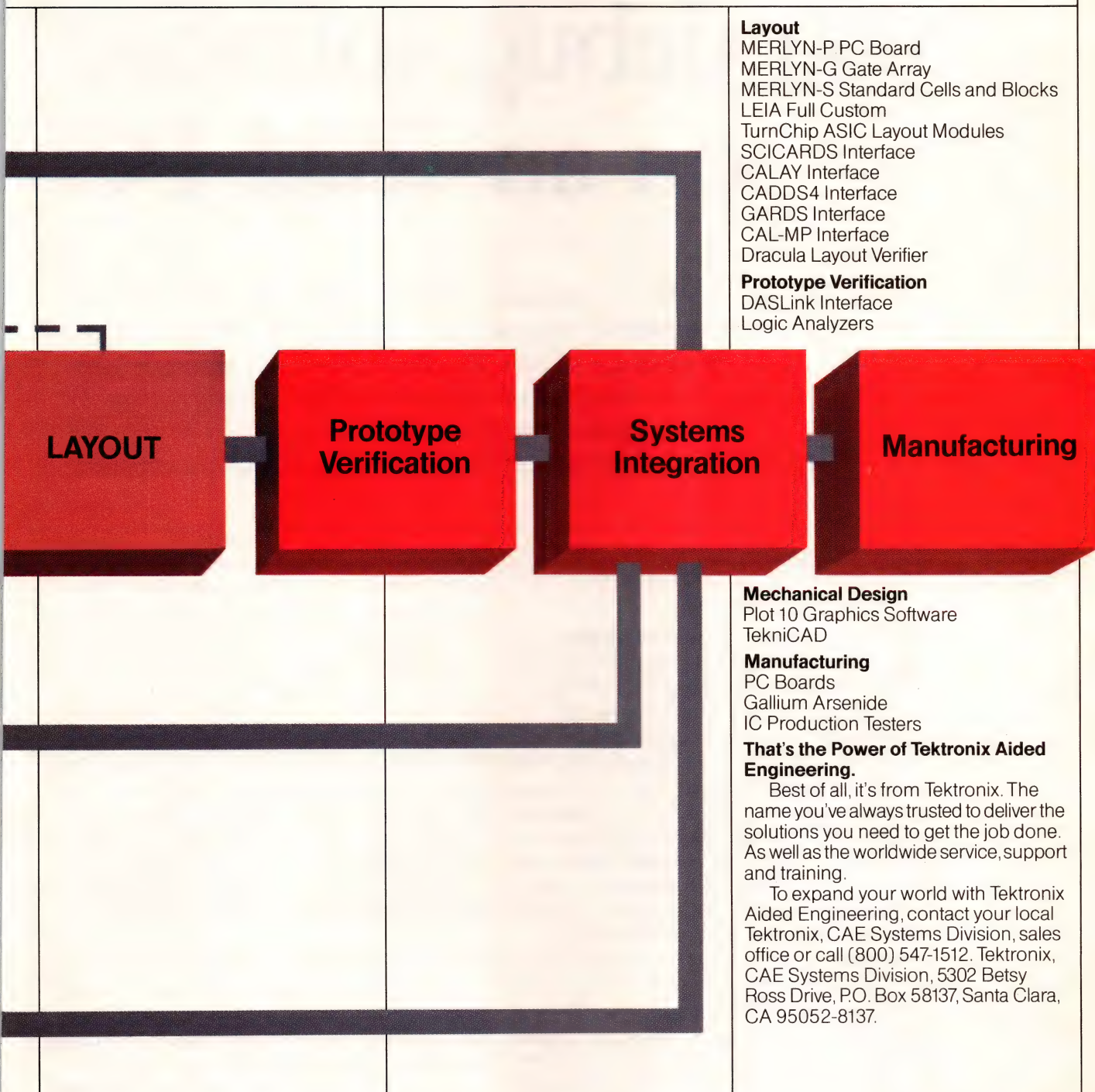
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*Software simulators that execute on the IBM PC and compatibles allow designers to debug ROMable software for a variety of  $\mu$ Ps. PC-based simulators generally offer more sophisticated software-debugging features than do expensive in-circuit emulators, yet they fit into the budgets of even small engineering departments.*

Maury Wright, *Regional Editor*

**Y**our personal computer can greatly ease the software-debugging tasks for your next  $\mu$ P-based design project. Microprocessor simulators that run on the IBM PC and compatible computers can help you debug even ROMable code for an embedded- $\mu$ P application. These simulators allow you to test and patch assembly code before you place the code in ROM. The simulators complement the function of an in-circuit emulator (ICE), and they can sometimes even replace an ICE. Furthermore, they're available for a variety of  $\mu$ Ps, and they can cost as little as \$75.

Microprocessor simulators allow the designer to test and debug assembly code, and sometimes high-level language, directly on a personal computer, regardless of the target hardware or processor (see **box**, "Compilers produce ROMable code"). The simulators allow you to observe and control program execution, set breakpoints, examine and modify registers and memory, time execution (in some cases), and even simulate peripheral circuitry. At the very least, the simulators can

examine and modify memory and registers and set simple breakpoints, capabilities equivalent to those of debugging tools such as DDT (for CP/M), Debug (for MS-DOS), and ODT (for DEC operating systems).

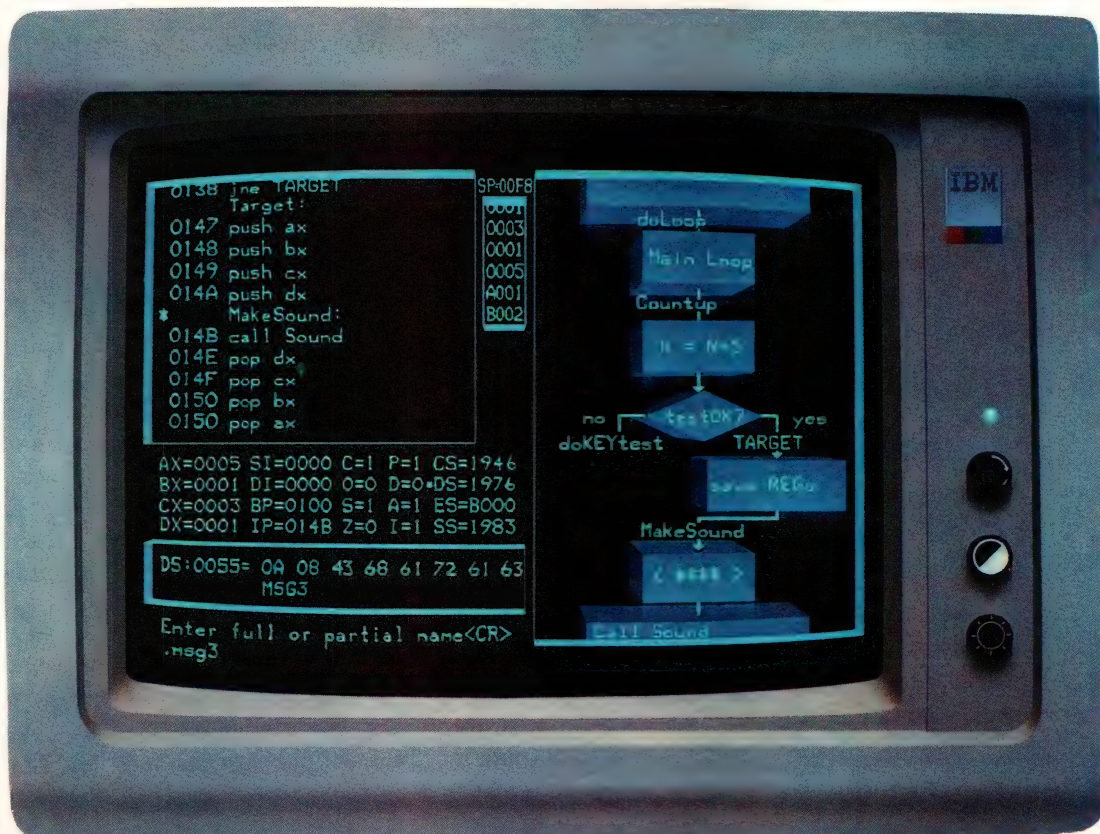
The difference between  $\mu$ P simulators and operating-system debugging programs such as DDT, Debug, and ODT is that these operating-system packages debug assembly-language code developed for execution on the host processor. A  $\mu$ P simulator, however, lets you debug software developed for a  $\mu$ P different from the host  $\mu$ P. Designers familiar with an operating-system debugging environment will easily understand a simulator's operation.

## **Simulation includes on-chip peripherals**

Microprocessor simulators exist for both general-purpose  $\mu$ Ps—such as the 8080, Z80, 6800, and 8088—and single-chip  $\mu$ Cs—such as the 8048, 8051, and 8096. The single-chip  $\mu$ Cs (sometimes referred to as microcontrollers) include a CPU similar to a general-purpose  $\mu$ P, and peripheral functions such as I/O ports, memory, and timers.

Simulators for microcontrollers are more complex than those for  $\mu$ Ps. Microcontroller





8088  $\mu$ P simulator (Cybernetic Micro Systems Inc)

simulators must handle not only the CPU but also the peripheral functions. When you choose a simulator for a microcontroller, you're likely to base your choice on the way the simulator handles the microcontroller's peripheral functions. Logical Systems' 8051 simulator, for instance, provides a buffer that lets you simulate input and output to the serial port.

To see how you could use a  $\mu$ P simulator to debug your ROMable code, consider the typical development cycle for  $\mu$ P-based designs. An engineer often performs software and hardware design simultaneously. When the hardware design is completed and the first prototype is built, hardware and software debugging begins in earnest. Although you can often use simple software routines to verify the operation of your hardware, to verify the entire design, you'll need completed and debugged software.

Consider, for example, a design that employs an Intel 8051 microcontroller. From Intel, you can purchase a development system that includes a development-station computer, a cross-assembler, and an ICE. You develop software on the computer and debug the

software and hardware with the ICE. You may also need other tools, such as a logic analyzer and an oscilloscope, to perform additional hardware debugging.

Although engineers have used ICEs to debug software for years, ICEs are optimized for hardware debugging, not software debugging. Microprocessor simulators are a much better choice for software debugging; they often have far more sophisticated software-debugging capabilities than those of even the most expensive ICE. For example, some simulators (those from Avocet and Cybernetic Micro Systems) can set breakpoints based on program-counter address, register contents, memory-location contents, a specific number of machine cycles, and even combinations of these factors. Although ICEs can set breakpoints, they can't generally set breakpoints based on all these conditions.

Furthermore, a simulator lets you easily set up and modify I/O conditions to test your software. Because ICEs are hardware tools, their I/O conditions are more difficult to modify.

Another advantage of using a simulator instead of an ICE to test code is that the



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## *With a personal computer and a $\mu$ P simulator, designers can debug and patch ROMable code.*

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simulator lets you debug software as soon as it's assembled, so you have the opportunity to debug your software before the hardware is even built. In contrast, before you can test code with an ICE, you'd have to load your code into ROM and into a real system.

### **Execution speed limits simulators**

Simulators do have limitations, however. They typically simulate the execution of code 1000 times more slowly than the code will actually execute. The slow simulation may prevent you from using the software to simulate large programs. What's more, certain conditions (for instance, a situation in which you need to find a bug caused by a race condition) may require you to employ an ICE to examine program execution in real time.

Compared with the other equipment you need for software development, a  $\mu$ P-based simulator is relatively inexpensive. For example, Mecklenburg Engineering offers a family of \$75 simulators for many popular  $\mu$ Ps and microcontrollers. The **table** on pg 200 lists available simulators for a number of  $\mu$ Ps and single-chip  $\mu$ Cs; the simulators range in price from \$75 to \$995.

The price of a development system like the one Intel offers, however, could easily exceed \$15,000. Even a less-expensive PC-based system, comprising a cross-assembler and an ICE, can be relatively expensive. For general-purpose  $\mu$ Ps, ICEs with very limited features start at \$500, but you can expect to pay \$2500 to \$10,000 for full-featured models. An ICE for a microcontroller will cost more, because it emulates the peripherals located on the chip.

No matter what kind of development system you buy, the cost of a  $\mu$ P simulator is a small fraction of the cost of an entire development system, so you may find it worthwhile to buy a  $\mu$ P simulator even if you're currently using an ICE. If your design doesn't require an ICE—not all designs do—the cost will be much lower. You can often debug microcontroller-based designs, and even hardware designs based on general-purpose  $\mu$ Ps, with nothing more than an oscilloscope and some simple test software.

The inexpensive simulators from Mecklenburg Engineering offer a simple, straightforward set of features. The programs operate in line mode for commands and status display. Line mode displays the screen dialogue

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## **Compilers produce ROMable code**

Personal-computer-based compilers, like PC-based simulators, can greatly ease your software-development tasks. A number of companies now offer PC-based compilers that produce ROMable code; these compilers allow you to write software—even software for embedded systems requiring ROMable code—in high-level language.

For example, Mark Williams Co offers a C compiler that produces ROMable code for the 8088. The \$495 compiler simply uses a different library than does the company's standard product. The software runs on an IBM PC, and you can even use the compiler to debug portions of your code on the personal computer.

Cross-compilers that you can

use to develop code for the increasingly popular 8051 microcontroller are also available. Intel sells a PL/M 51 compiler for \$750.

Other companies have developed cross-compilers for commercial languages such as C and Pascal. Scientific Engineering Laboratories, for example, offers a Pascal cross-compiler for the single-chip  $\mu$ C. The \$495 XPAS51 program produces an Intel hex file and a listing relating Pascal statements to an assembly-language representation. The compiler can also generate a map relating the names of variables, and it can label names to absolute addresses.

If you're more comfortable with C, you might want to use a program like Archimedes Soft-

ware's C-51PC compiler; it produces Intel hex code, assembly code, and symbol tables that are compatible with some in-circuit emulators. The \$995 program currently requires you to address 8051 on-chip functions with I/O addresses, but future versions will include mnemonics for functions such as the 8051 serial port.

The  $\mu$ P simulators discussed in the accompanying article will help you to track down bugs in your high-level-language programs. To trace program flow, you can use the assembly-language listings that the compilers produce. Furthermore, your high-level code will probably contain fewer bugs than assembly code would.



(the commands entered by the user and the program) on the screen, and the display scrolls upward. The programs operate in much the same way that the CP/M debugger DDT operates.

The simulators allow you to set one breakpoint based on the program counter, or based on the program counter and an iteration counter. In addition, a single keystroke starts execution at the current program counter, and execution will continue until the program counter returns to the starting value. This feature comes in handy for executing loops one iteration at a time. At any time during the execution of a program, you can also save the state of a simulation to disk or restore the state from a previously saved file. You can then restart the simulation from that point and then explore different paths through the code.

To single-step the Mecklenburg simulators, you press the space bar. You can also use the Q key to single-step through the program. The Q key, however, saves you from having to single-step through any subroutines that you don't need to debug. When you push the Q key, the simulator single-steps through the code until it gets to a subroutine call. At a subroutine call, it automatically executes the subroutine, then goes back to the main program and waits for another command.

These simulators also include two pseudo instructions that use op codes not used by the  $\mu$ P. The pseudo instructions allow the program to read or write to the personal computer's console. These instructions can be used to simulate I/O in the hardware design.

### Full screen supplies status data

For applications requiring more sophistication, consider using the simulators offered by 2500AD Software. The programs allow you to set 15 breakpoints in your code. You can trace the execution of your code and view a disassembled listing of the code. The programs operate by taking input from a command line at the bottom of the screen. The screen, however, provides status information, trace, and code in a standard full-screen display that's updated after the execution of each command.

The 2500AD simulators also accept commands entered via a batch file. The simulator's batch file is similar to an operating system's batch file; it gives the simulator a number of commands before returning control to the operator. The simulator programs also allow you to time execution in machine cycles, with a resolution of one machine cycle.

2500AD offers simulators for both  $\mu$ Ps and microcon-

6809		AVSIM 6809 Simulator/Debugger				V1.0	
CPU REGISTERS		FLAGS		SCL SPD DSP SKP CURSOR			
C	A:ACCUMULATOR	H N Z V C	OFF HI	OFF OFF	HEX		
0	11100000:08:0	0 0 1 0 0			Cycles: 1345		
B:	10000000:00:0	DP:0000			PINS	FLAGS	
addr data		NMI:1		E:1			
PC:0152	> 01 00 06 A1 84	EE 20	FIRO:1		F:0		
S:0040	> 00 00 00 00 00 00 00 00		IRO:1		I:0		
U:0000	> 00 00 00 00 00 00 00 00		ACIA: OFF				
X:0040	> 00 00 00 00 00 00 00 00		RDR:69:1		TDR:00:0		
Y:0046	> 00 00 03 54 68 69	00 00	Cti:10010110				
PTM Latch	Ctr Control Gt Ck IRO:0		Sta:00000000				
T1	E000 D743 01000110	0 0 0	PIA A 00000000				
T2	FFFF FFFF 00000001	0 0 0	3B 0 00110000				
T3	FFFF FFFF 00000000	0 0 0	CRB:00000100				
QY			CBI:0		CAZ:0		
003B	00 01 60 01 50 E0 00 03	00 00	PIA B 11111111				
0043	54 68 69	00 00 00 00	EB:0:11100000				
0010	FF FF FF FF FF FF FF FF		CRB:00000100				
0018	FF FF FF FF FF FF FF FF		CBI:0		CBZ:0		
ESC to command menu							

6809  $\mu$ P simulator (Avocet Systems Inc)

trollers, and the microcontroller products include simulation of all chip features. For example, the 8051 simulator provides registers you can read from or write to for each of the on-chip parallel and serial I/O ports. The serial-port register can also be linked to files for the input or output of streams of I/O data.

### FIFO buffer interfaces to serial port

The simulator from Logical Systems provides a 256-byte buffer for both the transmit and receive functions of the 8051 serial port. You can access the buffers from any simulator command that can access memory locations or registers. The simulator reads and writes to the buffers in FIFO mode.

Logical Systems offers simulators for the 8048 and 8051, and the products operate in a line mode. The programs support batch-file operation, code assembly/disassembly, and machine-cycle timing, and you can send the screen dialogue, including program trace, to a disk file or a printer. The simulators accept input in binary files or Intel or Motorola hex files.

The simulators provide 16 breakpoints based on the program counter. You can single-step through the programs or cause the simulators to execute a specific number of instructions. You can also set a breakpoint and specify a simulator command to be executed when the program encounters the breakpoint. This capability permits you to use breakpoints without completely halting execution of the program.

For example, for a known-good subroutine, you can set a breakpoint at the entry to the subroutine that turns the trace off and set a breakpoint at the end that



*Engineers familiar with operating-system debugging packages, such as CP/M's DDT, will find  $\mu$ P simulators easy to use.*

turns the trace on. Instead of suspending execution at the breakpoints, the simulator turns the trace off during the execution of the subroutine and turns it back on before returning to the calling program.

The Logical Systems simulators also allow you to assemble and execute one instruction at a time, so they essentially act as a language interpreter. The software continuously updates a 1k-byte history file that maps the addresses of the most recently executed instructions. The map lets you easily determine the most recent execution path or paths through your code.

#### Applications require friendly interface

If you need more complex breakpoints—for example, if you need to stop execution when you hit a snag or whenever you want to check status—you'll require a simulator that can set breakpoints on events other than program-counter addresses, yet still provide such features as the timing of program execution in machine cycles.

Cybernetic Micro Systems offers such simulators for complex applications. Most of the company's simulators are for microcontrollers, but it does offer one for a  $\mu$ P. These microcontroller programs simulate all on-chip functions, including the analog channel on the 8096. The company also offers an 8088/86 simulator whose features are more sophisticated than those of MS-DOS's Debug. A \$99 addition to the 8088/86 program helps you develop software for driving the IBM Enhanced Graph-

ics Adapter card.

These high-end simulators also offer a more sophisticated user interface than that of the simpler simulators. The Cybernetic Micro Systems simulators operate in full-screen display mode; the display is divided into code, flow, stack, command, register, memory, and help windows. The code and flow windows, which occupy most of the screen, provide you with an easy way to trace program execution. The code window displays the actual source code being executed, and the flow window provides a flow chart of program execution.

The code and flow windows provide a user-friendly interface, but to use the features you must assemble your code with a cross-assembler (\$295) from the company. You must also insert comments in your code according to guidelines spelled out in the simulator manual. You can send the code and flow diagrams to a printer to document a debug session; you can also send a program trace to the printer.

#### Terse commands speed operation

Commands to Cybernetic Micro Systems simulators consist of single-letter and control-character keystrokes. The commands are numerous—it takes about as much time to learn to use them as it takes to learn to use one of the more complex word-processing programs, such as WordStar—but they operate the programs effectively. Control-Q, for instance, acts as a

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*CYBERNETIC MICRO SYSTEMS	\$595	\$595	\$995			\$99							\$595		
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MECKLENBURG ENGINEERING	\$75				\$75		\$75	\$75	\$75	\$75	\$75	\$75		\$75	
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*A simulator with a flexible breakpoint structure can trap on addresses, contents of registers, memory locations, I/O ports, status flags, and counter/timers.*

---

toggle; it allows you to quickly step through a program. The Control-D and Control-F keystrokes allow you to speed or slow the execution rate when you use Control-Q for autosteping.

Other single-keystroke commands allow you to turn the code/flow windows on and off, reset the simulated microcontroller, single-step through the program, and execute at full speed with no display update. If a command requires additional data, the program prompts you for the input. The simulator also includes some commands that may be used only in macros. The program associates macros with function keys on your keyboard. The macros allow you to simulate stimulus or response at any pin or pins on the microcontroller. For example, you could use a macro to pass data to or from an I/O port.

The Cybernetic Micro Systems simulators provide a number of ways to control program execution. You can select the start and stop addresses in a run command, specify the number of instructions to be executed in a run command, or set 25 breakpoints based on program-

counter addresses. All of these program-flow commands operate in autosteping, run, and fast-execution modes.

The 8051 simulator also lets you set breakpoints based on the contents of registers, the program counter, the machine-cycle counter, I/O ports, counter/timers, the program status word, the data pointer, and the accumulator, or combinations thereof. The simulator allows you to set breakpoints with such conditions as equal-to, less-than, or greater-than, or any combination of these conditions. The breakpoints interrupt program execution only in autostep mode, however.

### **Simulator has flexible breakpoint structure**

The simulators from Avocet Systems are even more flexible; they allow an unlimited number of breakpoints. In addition to the breakpoints, or traps, supported by the Cybernetic Micro Systems products, the Avocet simulators allow you to trap on a binary basis by specifying a bit mask. With Avocet simulators, you can also choose breakpoints that stop execution once (temporary breakpoints), or every time a condition occurs. A delayed trigger can be specified for breakpoints, and you can specify read/write or write-only access for breakpoints that are based on memory or I/O access.

The Avocet programs also allow you to simulate stimulus and response at all  $\mu$ P or microcontroller pins. You can link disk files to the I/O pins to simulate operation in a live environment. Furthermore, batch files allow you to set up given situations quickly; the batch files permit you to run a number of commands with minimal user interaction.

The programs also provide a sophisticated operator interface. The programs display source code on the left side of the screen and status information on the right. The source code includes variable and label names rather than hex numbers, provided that your cross-assembler produces a suitable symbol table. The status display includes all pertinent registers, I/O ports, timers, interrupt information, memory segments, and flags. You may choose to display the data as hex, ASCII, or binary numbers. Furthermore, these simulators continuously display all the  $\mu$ P-status information on the screen.

### **Screen mode simplifies data entry**

The Avocet simulators operate in one of two modes; you use the Escape key to toggle between the display and the command modes. When the program's in display mode, the operator can modify any data displayed

---

### **For more information . . .**

For more information on the microcontroller simulators and compilers discussed in this article, contact the following manufacturers directly or circle the appropriate numbers on the Information Retrieval Service card.

**Archimedes Software Inc**  
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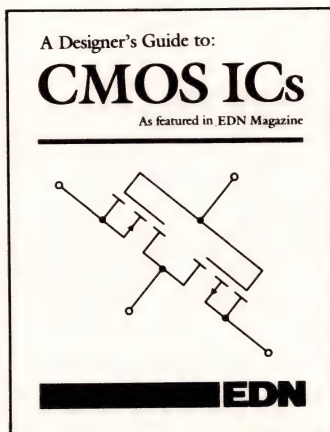
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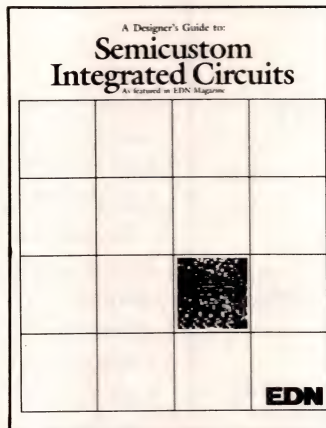


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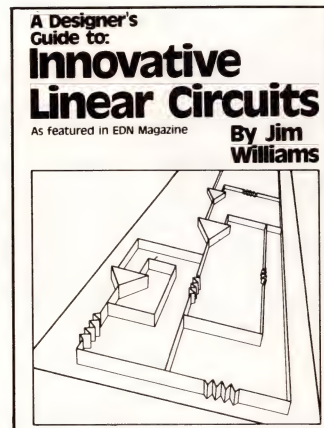
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on the screen by moving the cursor with the arrow keys and typing the new data over the old. Of course you can also modify multiple memory locations with a fill command from the command mode.

In command mode, the simulators accept commands on two lines at the bottom of the screen. The programs always display a choice of commands; to select a command, you simply type the first letter of the command. Depending on the command, the program might provide you with a secondary or tertiary choice or prompt you for appropriate data.

The function keys also simplify the operation of the simulator programs. You can use the F10 key for single-stepping or use F1 as a toggle to start and stop execution. F2, F3, and F4 allow you to set temporary breakpoints directly correlated to the source code shown on the display. In screen mode, F7 allows you to select between hex, ASCII, and binary modes of display. You may use F6 to designate certain areas of the screen that don't get updated during program execution. By limiting screen update, you can hasten the simulator's execution.

Avocet offers simulators for both  $\mu$ Ps and microcontrollers. The microcontroller programs simulate all on-chip peripherals. The company's programs for general-purpose  $\mu$ Ps even include support for some off-chip peripherals. For example, the 8085 simulator includes support for the 8155 and 8355, and the Z80 version supports the CTC and PIO chips.

Microcontroller and microprocessor simulators can also assist in debugging high-level language that's compiled in ROMable form. The compilers typically relate a group of assembly statements to a high-level statement. By using a list of such relations, you can track the execution of the high-level code.

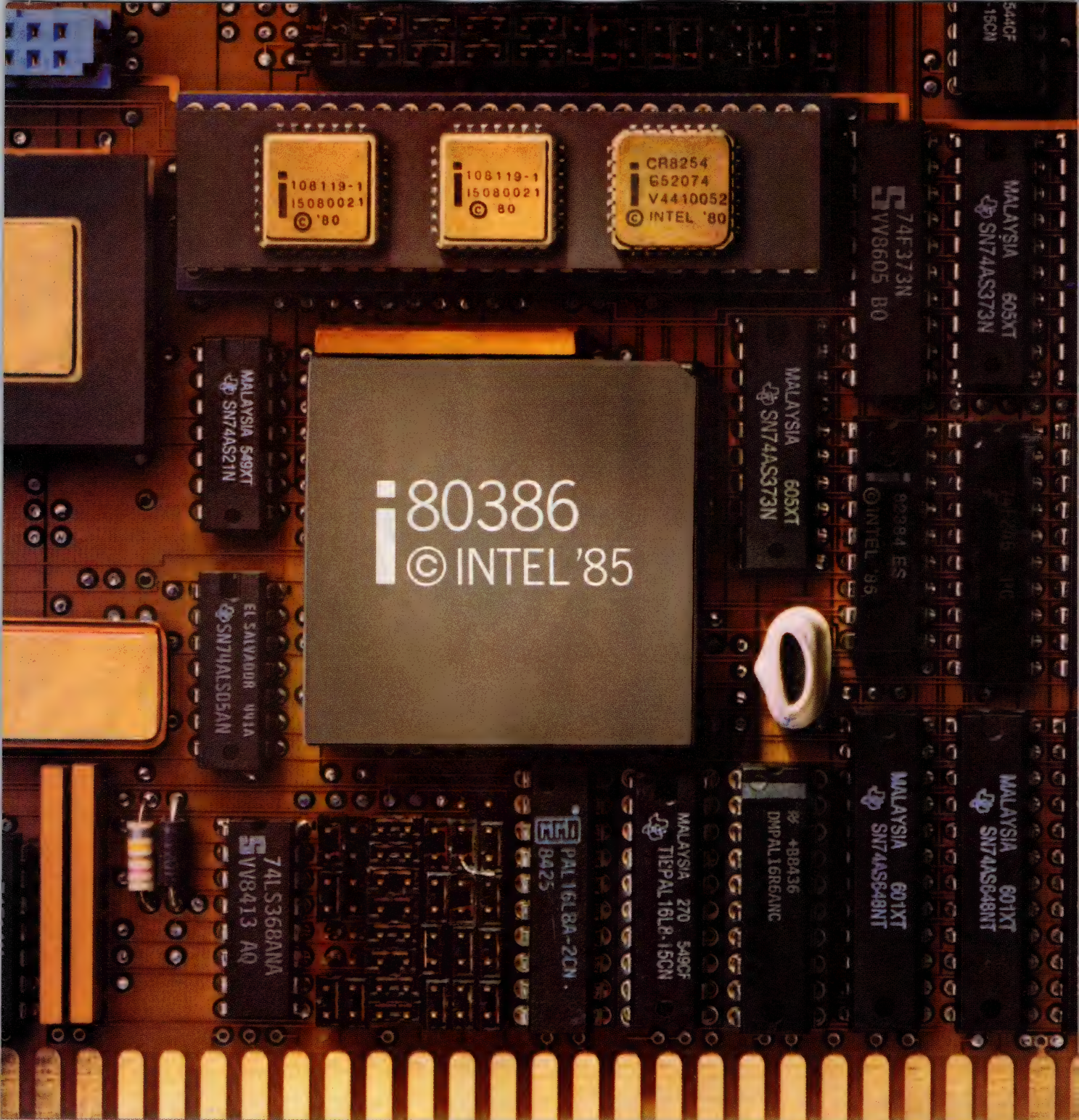
Furthermore, sophisticated high-level language debuggers for disk-based developments are already available; expect the next generation of simulators to support debugging of some high-level languages. **EDN**

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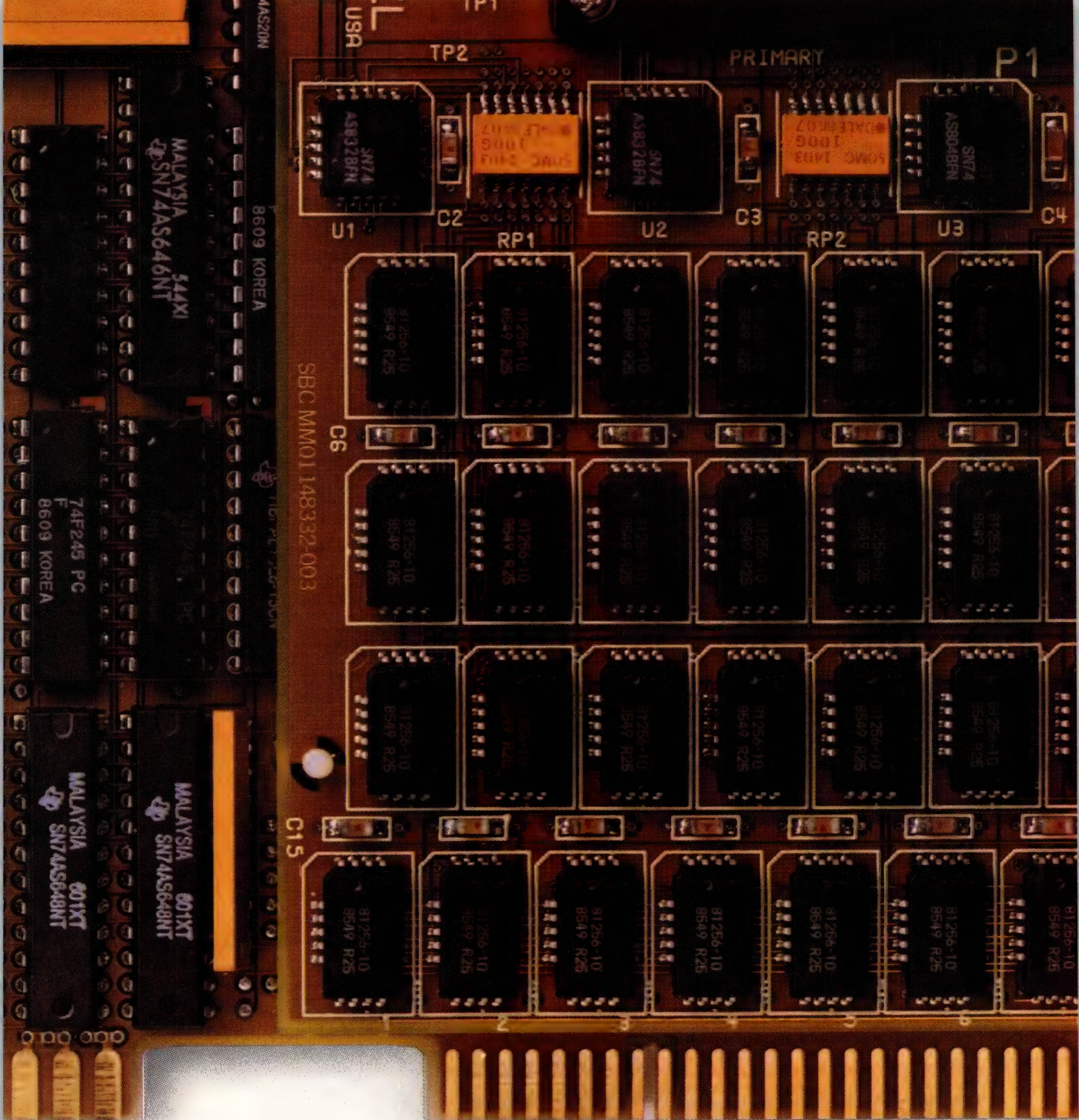
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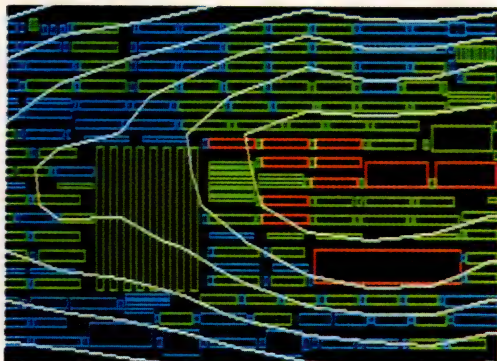
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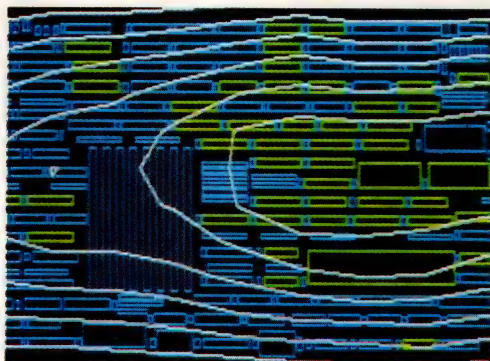
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# **Telesis**

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CIRCLE NO 131



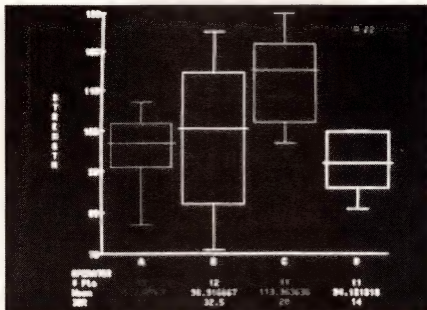
# Software

## Analysis package orders data into statistically significant variables

RS/Explore is a data-analysis software package that combines the vendor's RS/1 information-analysis module with a statistical advisory module. It runs on VAX minicomputers and on MicroVAX II and VAX workstations under the VMS operating system. The software helps you take a 4-stage approach to the analysis of a problem.

In the first stage, the program helps you organize your data into statistical variables and associates each variable with the descriptive information you need for analysis and interpretation. It automatically identifies important data characteristics and generates new variables from functions of existing variables.

In the second stage, the program generates a variety of scatter plots,



box plots, and multiple-correlation tables that help you identify the relationships between variables. You can also display histograms, probability plots, and descriptive statistics.

In the third stage, the program suggests appropriate statistical methods for further exploration of the problem; it bases its recommendations on the attributes and char-

acteristics of your data. The methods you can select include regression, analysis of variance, and analysis of covariance. The program alerts you if the data does not meet the basic statistical assumptions of the method you selected.

Finally, the program maintains a diary of all the analyses you performed. For each step, the program determines if a significant relationship exists between variables, provides English explanations of the results, assesses the adequacy of your model, compares alternative models, and makes predictions and comparisons. From \$9000.

**BBN Software Products Corp, 10 Fawcett St, Cambridge, MA 02238. Phone (617) 864-1780.**

Circle No 608

## Development tools let you design graphics applications using the 34010 graphics $\mu$ P

A set of development tools now supports the TMS34010 Graphics System Processor, which combines general-purpose 32-bit  $\mu$ P features with special graphics-processing hardware. You can control the TMS34010 with programs written in C or assembly code. Included in the development-tool set are an assembler, a C compiler, function libraries, an in-circuit emulator/debugger, and a software-development board.

The assembler package generates common object-file-format section-oriented object code for IBM PCs and compatible computers running MS-DOS 2.11 or higher. (Versions for VAX computers are also available.) The assembler package includes a 34010 simulator.

The C compiler for the 34010 supports full Kernighan and Ritchie C with extensions for in-line assembly code and enumerated data types. It has a 3-pass optimizing preprocessor, parser, and code generator that produces 34010 assembly source code. The compiler provides memory management and 64-bit floating-point operation.

The graphics/math software library includes graphics primitives, transcendental functions using double-precision floating-point math, matrix operations for 3-D transformation, text generation, view-port support, some basic fonts, and color-palette management. The font library has 19 different font styles and a range of pixel heights.

The XDS/22 in-circuit develop-

ment system provides real-time 34010 emulation. You can use the emulator in a stand-alone mode via a standard terminal or through a host computer with a debugger interface. The XDS/22 also performs full-speed hardware traces.

The 34010 assembler package costs \$500 for the IBM PC version. The C compiler costs \$1000; the graphics/math software library, \$10,000; and the font library, \$5000. The XDS/22 development system costs \$14,995.

**Texas Instruments Inc, Semiconductor Group, Box 809066, SC-636, Dallas, TX 75380. Phone (800) 232-3200.**

Circle No 607

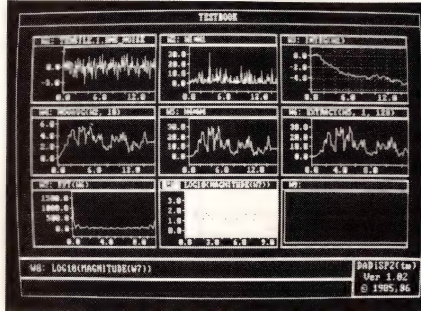


# Software

## Engineering spreadsheet provides post-acquisition signal analysis

Dadisp II provides post-acquisition data analysis in a spreadsheet format on IBM PCs and compatibles. Unlike conventional business spreadsheets, it isn't limited to basic math formulas. The program also supports complex engineering functions such as trigonometric, logarithmic, calculus, and statistical functions. In addition, the program can generate trigonometric and hyperbolic waveforms for display and manipulation by other windows in the spreadsheet. You can transfer any ASCII or binary file of raw data into its database.

The program can display as many as 64 waveform windows at a time, and you can enlarge and overlay any of the windows. You can display a



previously acquired signal in one window and set up a sequence of transformations or formulas in other windows. For example, to find the convolution of an acquired signal with a sine wave, you'd load the acquired signal into one window, generate a sine wave in a second window, and enter the  $CONV(W1,W2)$  formula in a third

window. Any change you introduce in the two independent waveforms will propagate through to the dependent waveform in the third window.

The Dadisp II software package costs \$795 and runs on an IBM PC/XT, PC/AT, or compatible computer with a minimum of 512k bytes of RAM; a color monitor; and a color graphics adapter, enhanced graphics adapter, or Hercules graphics card. The manufacturer also offers Dadisp I (\$995), a data-acquisition module for the Keithley 500 series of data-acquisition hardware.

**DSP Systems, 1 Kendall Square, Building 200, Cambridge, MA 02139. Phone (617) 577-1133.**

Circle No 606

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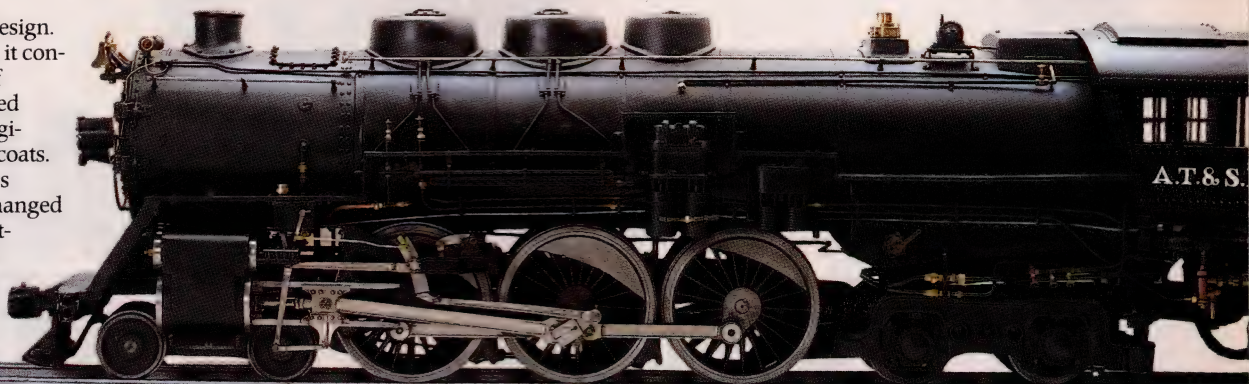


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## Introducing AutoCAD 2.5

Of course, the newest version of AutoCAD still has all the features that made the original the industry standard. Accuracy, Power, and Versatility.

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For example, AutoCAD performs most PAN and ZOOM operations five to ten times faster than the previous version. So design and redesign are faster than ever.

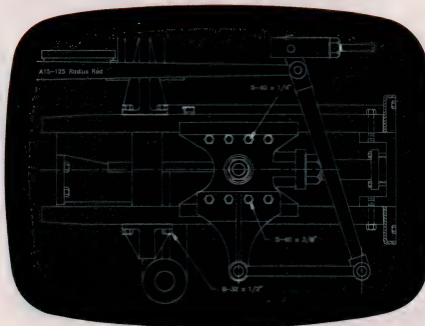
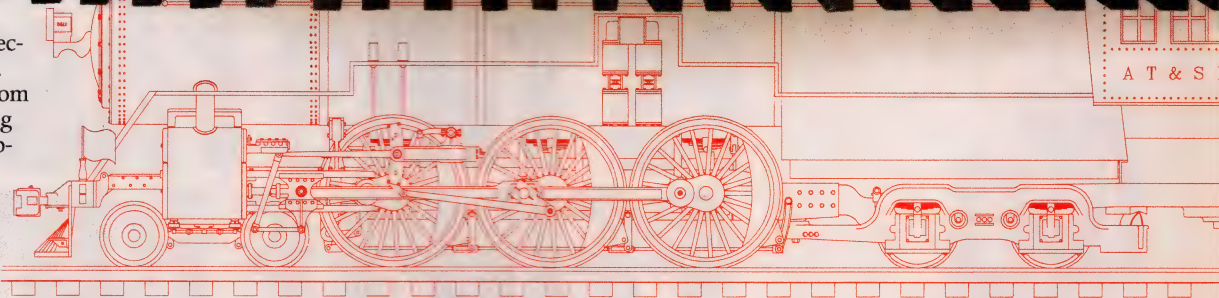
There is also a wealth of new commands for creating ellipses, doughnuts, and polygons. And new editing commands that let you STRETCH, TRIM, EXTEND, ROTATE, SCALE, and EXPLODE objects.

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CIRCLE NO 134

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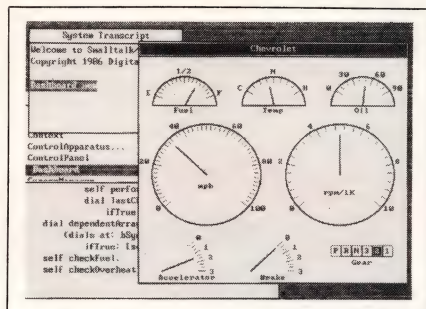
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# Software



## LANGUAGE FOR PC

Smalltalk/V is an implementation of the vendor's nongraphics version of this object-oriented programming language. The features include bit-mapped graphics, windows, support for a Microsoft or compatible mouse, a Pro-Log compiler, and a source-level debugger.

Object-swapping virtual memory lets you store defined objects on disk and bring them into main memory as needed; the process is transparent to you and lets you construct very large programs without the use of extended memory. Turtle graphics simplify the manipulation and animation of graphics objects; you can define different behavior for each object and link them to each other through the message-passing feature of Smalltalk. Thus, you can perform simulations in which objects on the screen can modify each other's behavior. An optional software interface lets you communicate with host computers, running Unix and other operating systems, over an RS-232C link. \$99; communications interface. \$49.

**Digitalk Inc, 5200 W Century Blvd, Los Angeles, CA 90045. Phone (213) 645-1082.**

Circle No 611

## CROSSASSEMBLER

The X68000 crossassembler allows you to produce object code for 68000, 68008, and 68010  $\mu$ Ps on IBM PCs and compatible computers running PC/MS-DOS, on VAX computers running VMS or Unix, and on PDP-11 and 68000-based computers running Idris or Unix. The assembler produces absolute or relocat-

able object code, and it includes such features as parameterized macros and repeats, conditional assembly, and multiple file assembly. It also allows you to divide programs into separate program and data sections and to define global or temporary labels.

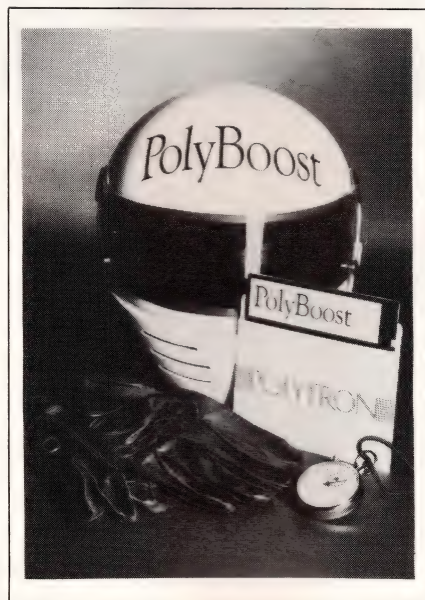
The assembled code is optimized by automatic selection of long or short conditional jumps for span-dependent instructions. The assembler's symbol table has a capacity of greater than 32,000 entries, and you can transfer the symbol table to and from disk while maintaining control over the number of entries resident in the system's memory. From £800 for a PC/MS-DOS system to £2160 for a VAX/Unix system, including 12-month software support.

**Real Time Systems Ltd, Box 70, Douglas, Isle of Man, UK. Phone (0624) 26021. TLX 628356.**

Circle No 610

## PC ACCELERATOR

Polyboost comprises three memory-resident programs that speed up keyboard input, screen display, and disk access, respectively. You can load any or all of these programs independently. It runs on the IBM PC, PC/XT, and PC/AT. The DSKboost program lets you set up a cache buffer to reduce the number



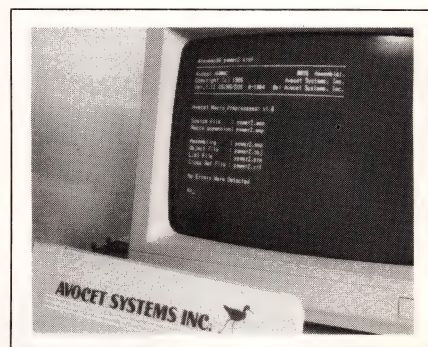
of times your application program must physically read from the disk. When you enter new data from the keyboard, this program immediately copies it to the disk and updates the cache buffer.

Instead of using the BIOS display routines, the CRTboost program routes data directly to the screen. This method gives you faster scrolling and text display and eliminates the flicker normally associated with the IBM color graphics adapter. The Keyboost program lets you adjust the repeat rate of cursor and character keys and increases the size of the type-ahead buffer to 128 bytes to ensure that you won't lose data if you continue typing during a disk access.

Keyboost also has a command-line editor that lets you recall, edit, and execute DOS commands. According to the vendor, you can use this package to run computation-intensive programs two to five times faster and disk-intensive programs as much as 10 times faster. \$79.95.

**Polytron Corp, 1815 NW 169th Place, Suite 2110, Beaverton, OR 97006. Phone (800) 654-5301; in OR, (503) 645-1150. TLX 325800.**

Circle No 609



## MACROASSEMBLERS

The Avmac relocating macroassembler packages include a preprocessor for generating macros, using structures resembling those of Masm and RMac; a cross-reference generator; a linker; a library manager; and a utility for converting hexadecimal object files to binary. Assemblers are available for most



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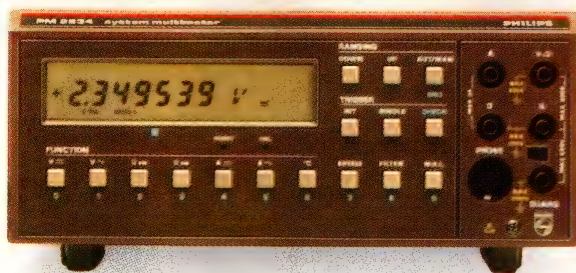
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# Software

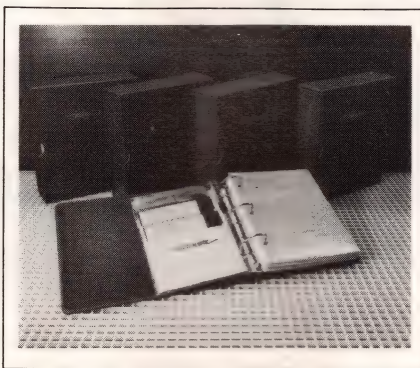
32-bit, 16-bit, 8-bit, and 4-bit micro-processors and controllers.

Each assembler can process source code for any one of the chips in a given family; the Avmac68, for example, can process code for 6800, 6801, 6802, 6803, and Hitachi 6301 chips. The software takes into account the flags and addressing modes of the chip you specify and accepts address ranges for ROM, RAM, and I/O. Each assembler performs checks to see that address references are valid.

Each assembler in the series is available for PC-DOS/MS-DOS hosts, for VAX hosts running VMS, and for VAX hosts running Unix. Prices vary according to the host and the target CPU. For PC-DOS, from \$349; for VAX, from \$995.

**Avocet Systems Inc, Box 490, Rockport, ME 04856. Phone (800) 448-8500; in ME, (207) 236-9055. TLX 467210.**

Circle No 612



## OS FOR 68020

The OS/9-68020 multiuser, multi-tasking operating system is coded in native 68020 assembly language. The kernel, the disk-file manager, the command interpreter, the character-file manager, and the I/O drivers are independent, linkable program modules. You can build a customized version for your application by including only the modules you need, and by writing I/O drivers for nonstandard devices.

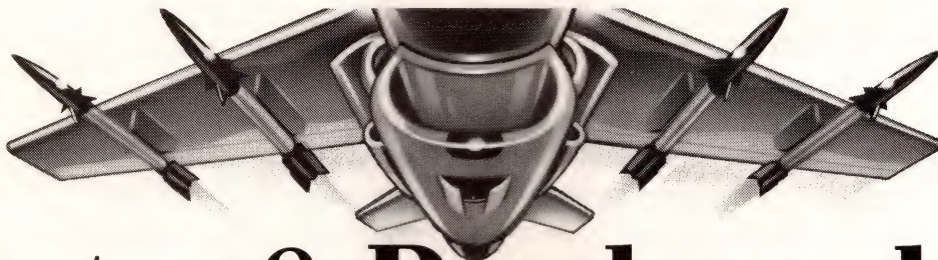
The operating-system executive,

when fully configured for disk I/O, occupies no more than 24k bytes and can reside in ROM. The system includes the memory-management and page-fault-detection logic that demand-paging virtual memory requires.

Among its features are pipelines for intertask data transfer; data modules that allow a memory block to be shared by multiple tasks; record locking to assure data integrity when multiple users access a common database; group and user identification codes to ensure file-system security; and signals for the control and synchronization of real-time processes. The operating system comes with a screen editor and line editor, a macroassembler, a debugger, and a C compiler. \$950.

**Microware Systems Corp, 1866 NW 114th St, Des Moines, IA 50322. Phone (515) 224-1929. TLX 910-520-2535.**

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# Software



## COMM PACKAGE

The Excelan Open System (EXOS) 8016 Transmission Control Protocol/Internet Protocol (TCP/IP) software provides high-speed communications between an IBM RT PC and a host computer over an Ethernet link. The software runs on the RT PC under IBM's Aix operating system (a superset of AT&T's Unix

System V); it works in conjunction with the Exos 205 intelligent Ethernet controller to provide a local-area network subsystem, over which the RT PC can communicate with dissimilar hosts such as VAX machines or supermicros that run under either VMS or Unix.

The package includes two end-user utilities; one provides high-speed file transfer; the other emulates virtual terminal. The software includes most of the standard 4.3 BSD remote Unix utilities that let you log on to a remote-system, execute commands, check the status, and copy files and directories. The package conforms to the DoD specifications for DARPA (Defense Advanced Research Projects Agency) TCP/IP, as well as to MIL-STD-1777 and -1778. \$1295.

**Excelan Inc, 2180 Fortune Dr, San Jose, CA 95131. Phone (408) 434-2300.**

Circle No 620

## AI TOOLS

Personal Consultant Easy and Personal Consultant Plus are expert-system development tools with graphics features. The Easy version runs on the IBM PC and PC/XT and some TI personal computers; the Plus version runs on the IBM PC/AT or TI Explorer and can handle larger, more complicated application problems.

The Easy version has all the basic facilities for generating an expert system, including a rule-entry language, a window-oriented editor, and rule-validation and debugging aids. The program performs calculations to handle uncertain or incomplete user input, allows you to specify the order in which rules are tried during the inference process, and lets you find out how information was determined. You can incorporate data from DOS or dBase files into decision processes.

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# Software

bilities of the Easy version and also lets you create compiled Lisp functions to solve difficult problems or customize an application. Plus allows you to use frame descriptors capable of inheriting properties of a parent frame in order to organize complex problems into a series of subproblems. The program lets you create metarules to supply information on how best to apply the other

forms of knowledge. It also lets you couple an application to other programs such as communications packages or video-disk databases.

Personal Consultant Easy, \$495; Personal Consultant Plus, \$2950.

**Texas Instruments, Knowledge Engineering Services, M/S 2195, Box 2909, Austin, TX 78769. Phone (800) 527-3500.**

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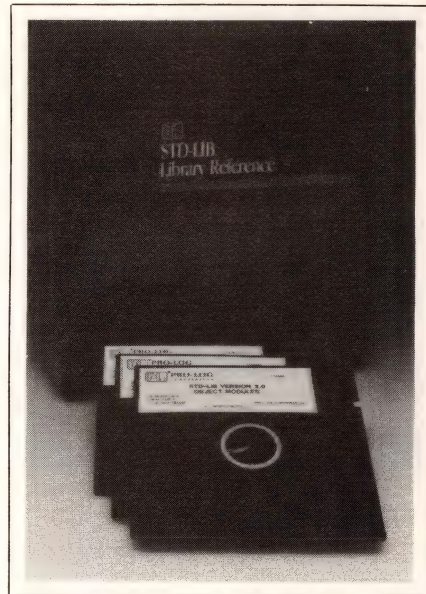


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CIRCLE NO 141



## STD BUS LIBRARY

The STD-LIB 2.0 is an enhanced library of peripheral-initialization and -driver routines for STD Bus-based computers and controllers running MS-DOS. The library routines link application programs written in Microsoft C, Basic, or macroassembler languages to 22 different serial I/O, keyboard/display, process-control, and analog I/O peripheral interface cards manufactured by the library vendor and by Analog Devices.

All the routines are written in 8086/88 assembly language. The library package includes linkable object-code modules; source code to allow customization of any routine; and a reference manual that presents a functional description of each module, its parameter requirements, and examples of its use. Uniform parameter-passing conventions eliminate the need to write special linkages. \$395.

**Pro-Log Corp, 2560 Garden Rd, Monterey, CA 93940. Phone (408) 372-4593. TWX 910-360-7082.**

Circle No 615

## STATISTICS PROGRAM

Systat 3 is an enhanced version of a comprehensive statistical package. The enhancements include both menu-driven and batch operating



# Software

modes; covariant models; test-analysis routines; a mouse-activated spreadsheet; and a clipboard. The Nonlin module lets you compute nonlinear and piecewise regression, least absolute values, and maximum-likelihood estimation.

You can enter the models and loss functions by typing the equations at the keyboard. One statement automatically generates orthogonal and nonorthogonal repeated-measures models. Optional supplementary modules include Logit, a maximum-likelihood multinomial module; Testat, which computes reliability statistics and estimates parameters for the Rasch model; and Sta/Transfer, which lets you transfer files between this program and Lotus 1-2-3, SPSS (SPSS Inc, Chicago, IL), and Stata (Stata Corp, Los Angeles, CA) programs. The program is available for the IBM PC, PC/XT, PC/AT, and compatibles; generic MS-DOS machines; the Macintosh;

VAX/VMS and VAX/Unix; HP9000; and selected 68000-based Unix systems. From \$595.

**Systat Inc, 2902 Central St, Evanston, IL 60201. Phone (312) 864-5670.**

Circle No 614

## FORTH ASSEMBLER

PC/Assembler is an interactive, syntax-checking assembler for  $\mu$ Ps and math coprocessors belonging to the Intel 8086, 80186, and 80286 families and the NEC V20/30 family. The program lets you write assembly-language routines or subprograms that you can invoke from an application program written in a high-level language. The assembler produces .COM files for use by Turbo-Pascal programs, and it generates .BLO files for use by programs written in Basic or Version 1 of IBM Basic. The assembler lets you construct .OBJ files for use in

programs written in QuickBasic, Version 2 of IBM Basic, or any high-level language that supports the Intel Relocatable Object Module format. Written in Forth, the package includes a Forth operating system; an editor similar to Wordstar; a linker; a loader; and all required interfaces to PC-DOS, MS-DOS, and the BIOS. \$99.

**Computer Systems Documentation, Box 5478, Albuquerque, NM 87115. Phone (505) 292-7037.**

Circle No 616

## BASIC FOR STD BUS

STD Basic is a floating-point Basic compiler that resides in ROM on the vendor's 890 CPU card for the STD Bus. The compiler has all standard Basic commands and functions plus 44 commands that communicate with STD Bus peripheral interface cards at the bit-, byte-, or 16-bit-word level.

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☐ Tracer, the multitask debugger  
☐ High level language interface libraries

### My development host(s):

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# Software

Seven other commands perform calculations on whole data arrays. Applications include digital I/O, motor control, analog data acquisition, linearizing transducers, and frequency measurement. The interpreter performs all calculations with 7-digit precision. You can make variable names any length; strings and program lines can have as many as 255 characters. You can store a debugged program in EPROM and then plug the EPROM chip into a special socket on the CPU card; when you turn on the power, that program will automatically start running. \$445.

**Octagon Systems Corp, 6510 W 91st Ave, Westminster, CO 80030. Phone (303) 426-8540.**

Circle No 618

## PC-BOARD TESTER

Probot Adjacency Software is a self-contained test-generating program

for use with a Probot Series Six test instrument. The program obtains its inputs from the Gerber-format plotter files generated by your CAE software. From these Gerber files, the program determines the location of the copper on each layer of a bare printed-circuit board, and the locations of the interconnects between each layer. From this information, the program creates a test file that defines the X-Y coordinates of the test sites in each individual net. The program uses this net file to determine which nets are adjacent to each other; it then creates an adjacency file that optimizes the tests needed to check for open circuits within a net and short circuits between nets.

Using the adjacency file as input, the test instrument can test a printed-circuit board as large as 24x27 in.; the probes have no grid restrictions and can perform as many as 600 tests per minute with a

minimum probe spacing of 0.010 in. The software runs on an IBM PC/AT or a compatible machine. \$10,000.

**Owl Electronic Laboratories Inc, Pequot Industrial Park, Westbrook, CT 06498. Phone (203) 399-5951.**

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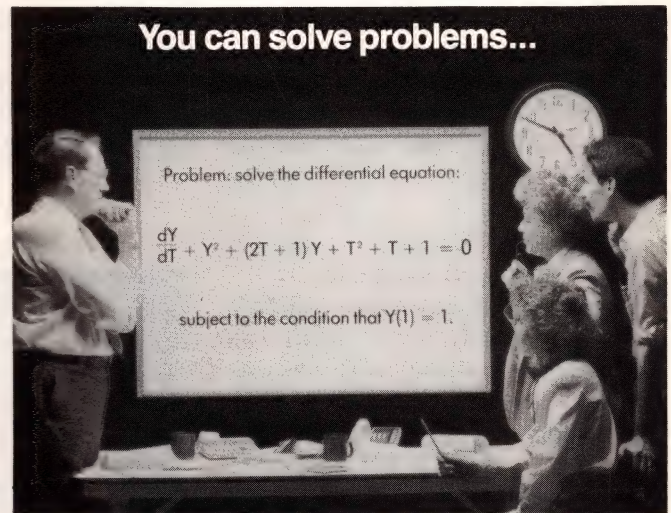
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- Symbolics 3600™ Series
- SUN-2™ & SUN-3™
- VAX™, VMS™ & UNIX™
- Masscomp™ MC5500™

Other versions will be following soon.



## Symbolically...

```
(C1) DEPENDS(Y,T);
(C2) DIFF(Y,T)+Y^2+(2*T+1)*Y+T^2+T+1;
(D2) dY/dT + Y^2 + (2T+1)Y + T^2 + T + 1
(C3) SOLN:ODE(D2,Y,T);
(D3) Y = - %CT%E^T - T - 1
          %C%E^T - 1
(C4) SOLVE(SUBST([Y=1,T=1],D3),%C),NUMER;
(D4) [%C = 0.5518192]
(C5) SPECIFIC SOLN:SUBST(D4,SOLN);
(D5) Y = - 0.5518192 T %E^T - T - 1
          0.5518192 %E^T - 1
```

## and Numerically.

```
(C6) FORTRAN(D5)$
Y = -(0.5518192*T*EXP(T) - T - 1)
1 /(0.5518192*EXP(T) - 1)
```

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## Software

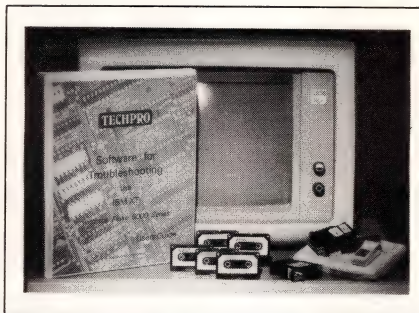
other pointing device to manipulate GPSS entities through any of six interactive graphics windows. The package implements approximately 95% of the GPSS V standard blocks, and many new features, not available in GPSS V. The value and precision of the system clock are limited only by the main memory capacity and time resolution of the hardware; likewise, internal statistics are stored as integers that have no inherent precision limits.

If the system hardware configuration allows it, the program can use extended memory with a capacity as large as several megabytes. The number of parameters per transaction, of random-number generators, of entities of any type, and of chains occupied by a transaction is limited only by the amount of memory available. The program also provides interfaces to other statistical packages, facilities for animation from real-time data, and net-

work communications. Other features allow you to access and modify state variables and simulation primitives interactively from the keyboard during a simulation. \$995.

**Minuteman Software, Box 171, Stow, MA 01775. Phone (800) 223-1430; in MA, (617) 897-5662.**

Circle No 622



### DIAGNOSTICS

Guided Fault Isolation (GFI) software takes you, point by point, through the circuitry of a faulty

IBM PC or PC/XT, automatically bypassing areas in which no faults exist. Versions are also available for computers from Compaq, Convergent Technologies, Burroughs, and Prime. Tests perform go/no-go checks of the PC's system board, asynchronous communications adapter, color graphics adapter, monochrome board, and printer adapter, and provide failure codes that you can use as input to the GFI tests.

To run the software, you need a Fluke 9010A or 9005A Microsystem Troubleshooter equipped with an 8088 pod; you also need an oscilloscope to examine and verify the data and handshaking signals of the serial communications ports. For PC, \$1450; for PC/XT, \$1500; for Compaq, \$1750.

**Techpro Corp, Box 5294, Springfield, VA 22150. Phone (800) 445-7800; in VA, (703) 550-8898.**

Circle No 617

Continued on pg 234

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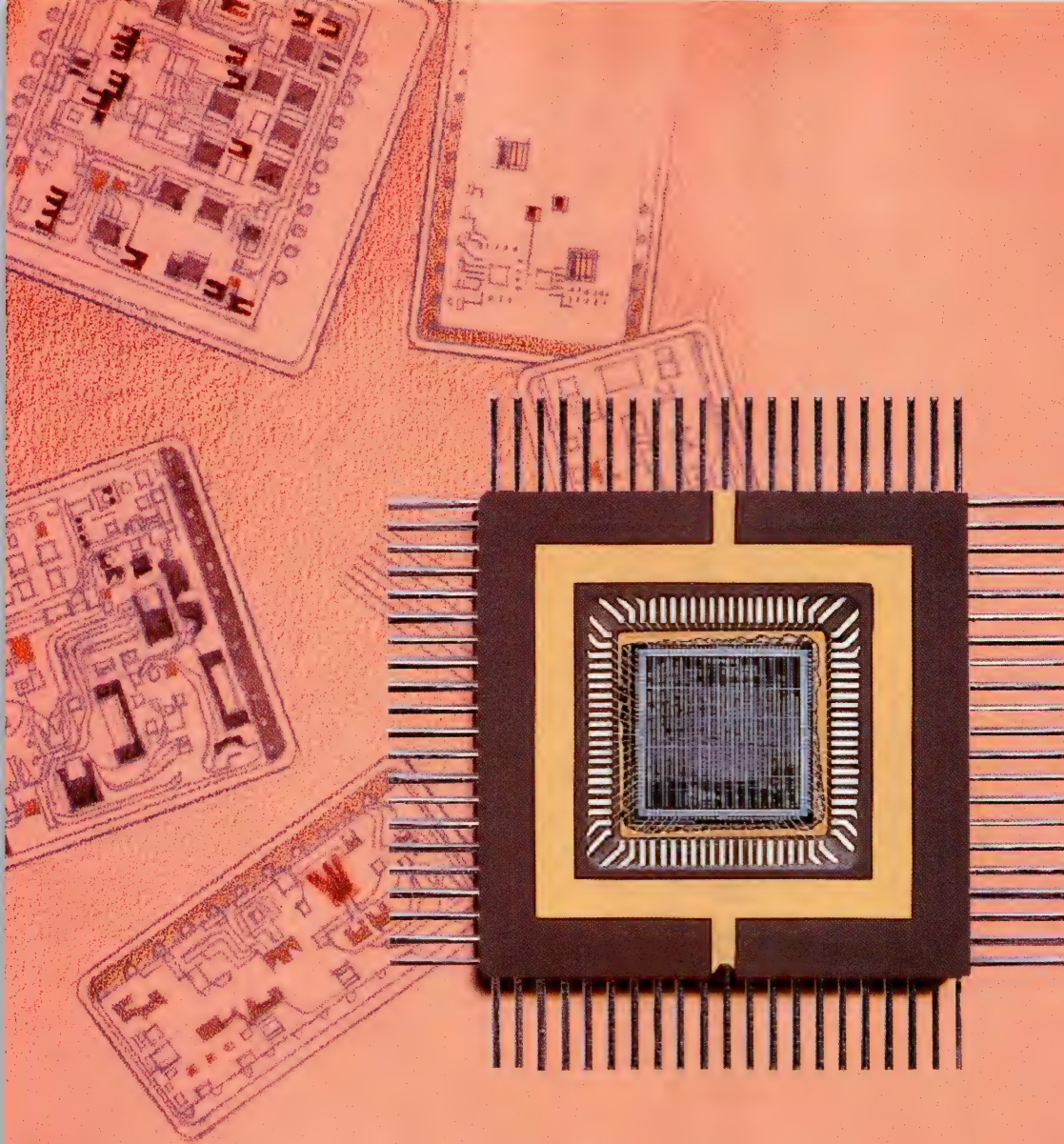
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The BCRT complies with the standard LAN used for military systems while meeting selected tests in MIL-STD-883C. It is available in 84-pin LCCs, PGAs, or Cerquads.

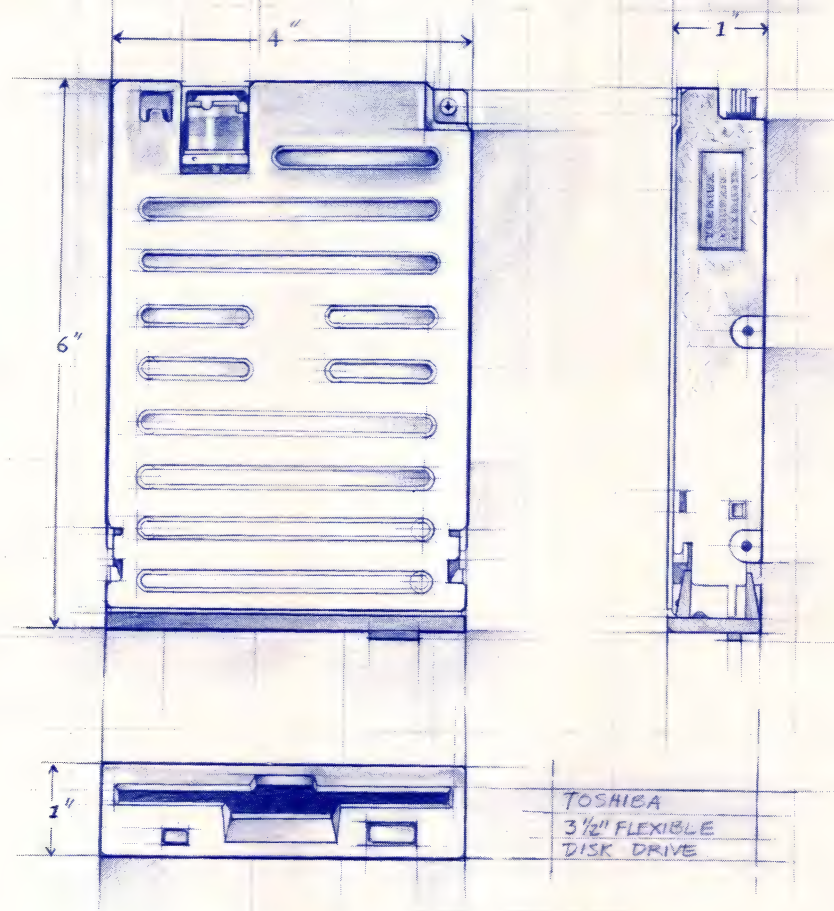
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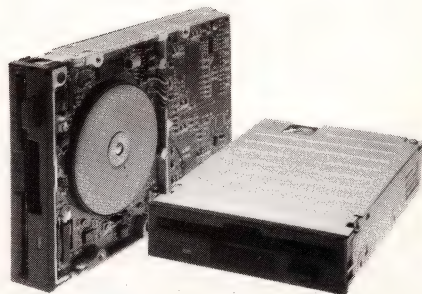
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**CIRCLE NO 151**



# Software

## ADA COMPILER

An application compiled with the PC/AT Ada Compiler can run in virtual mode; as a result, the software can directly access as much as 16M bytes of memory on an IBM PC/AT or a compatible computer. Using this compiler, you can avoid dividing a large application into overlays, and you can also avoid processing delays caused by moving blocks of the overlaid code to and from memory as well.

The conversion tool translates each compilation unit into object code for the 8086  $\mu$ P family. The program's library manager can create, delete, copy, and rename the Ada program library. Its unit manager examines and maintains individual units in the Ada program library, and its binder checks and combines separately compiled units into a single object program. The run-time executive is a set of routines that allocates memory for data

storage while an Ada program is running; manages exception handling; and controls tasking. The price includes a 4M-byte memory board. \$2995.

**Alslys Inc, 1432 Main St, Waltham, MA 02154. Phone (617) 890-0030. TLX 948536.**

Circle No 624

## DISK BACKUP

Automatic Backup lets you define full, incremental, snapshot, and partial disk-copy operations for all computers in DEC's VAX product line. Once you have defined the operations, the program can automatically repeat them at daily, weekly, biweekly, monthly, or quarterly intervals. If daily backups are inadequate, the program will perform midday incremental backups without interfering with ongoing operations. You can perform snapshots at intervals spaced from one to four

hours apart, and you can do a snapshot backup as many as nine times per day.

Normal initiation of backup operations is from a menu; however, you can also initiate them with a DCL (Digital Command Language) call that either executes the backup immediately or waits for a specified clock time before starting execution. Unauthorized users may initiate partial backups that relate to their own accounts; only users with a security privilege may initiate full, incremental, or snapshot backups.

You can restore files from any of the four backup modes. You can also perform local backups to tapes, disks, or writable laser disks, or to a remote host computer across a DECnet/Ethernet network, provided that the remote host is also running the VMS operating system. For each successful or unsuccessful backup request, a report goes to the

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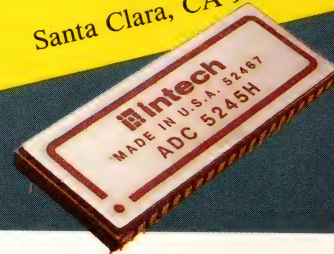
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# Software

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**Syco System Communications Inc., Box 838, Leominster, MA 01453. Phone (617) 534-6499.**

Circle No 621

## ANALOG SUPPORT

The PCI-20046S-1 Basic language package provides you with high-level access to this vendor's PCI-20000 system for data acquisition, test, measurement, and control products. The program is compatible with PC-DOS 2.0 or higher. It provides assembly-language subroutines that perform all major functions of the PCI-20000 system. You can call these subroutines from application programs written in Basic or other high-level languages or from assembly-language programs.

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**Burr-Brown, Box 11400, Tucson, AZ 85734. Phone (602) 746-1111. TWX 910-952-1111.**

Circle No 625

## ANALYSIS TOOL

Processplug is a process-control training and analysis tool that runs on an IBM PC, PC/XT, PC/AT, or compatible computer. It can simulate any of seven different menu-selectable controller types: an ideal controller, a model-based controller, and five categories of industrial controllers. Using time-response or open-loop frequency-response plots, the system can display responses in the load or in the parameters set by

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**Gerry Engineering Software, 13310 W Red Coat Dr, Lockport, IL 60441. Phone (312) 257-5950.**

Circle No 626

## RELIABILITY PROGRAM

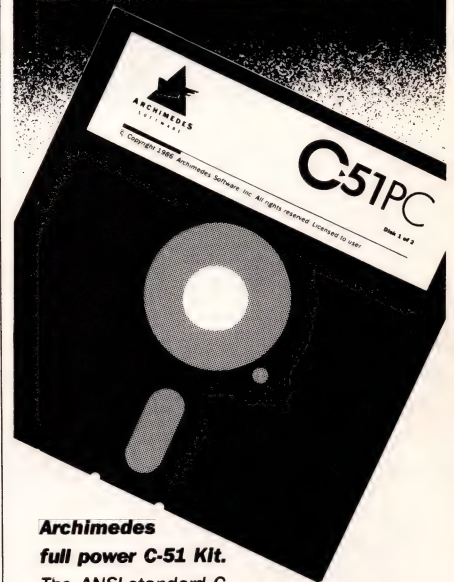
The Parts Count Reliability Program (RPC-1.0) implements the parts-count methods of MIL-HDBK-217. It helps you analyze the failure rate of individual components, single assemblies, or an entire system. Written for circumstances where a full parts-stress analysis is unnecessary, the program can provide two component-level and two system-level reports.

You can also use it to generate hard copies of formatted reports. The software lets you edit a design for a system or for individual components. A global-change option allows you to recalculate failure-rate data under varying environmental conditions. The program runs under MS-DOS on an IBM PC, PC/XT, PC/AT, or compatible computer having 256k bytes of memory. \$500.

**Powertronic Systems Inc, Box 29109, New Orleans, LA 70189. Phone (504) 254-0383.**

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CIRCLE NO 148



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CIRCLE NO 146





# User-configurable power supplies speed development

**Y**ou can choose from among several solutions when faced with the problem of providing multiple power-supply outputs for your designs: You might first consider using a battery of single-output supplies, designing with a standard supply in mind, designing an in-house supply, or sending specs to a power-supply company for a custom unit. But there's yet another option: employing a user-configurable supply.

If your design won't accommodate a standard supply, and if you don't want to design a supply in house or wait for a manufacturer to design and build a custom model for you (see **box**, "Multiple-output-supply alternatives"), then you might opt for a user-configurable modular supply. Such supplies present an appealing solution because they offer the advantages of flexibility, fast turnaround, easy expandability, and little or no waiting for agency certification. The power-supply maker provides a backplane into which you plug your choice of the manufacturer's output modules. Because a user-configurable supply uses off-the-shelf modules and backplanes, you can have a working, properly sized supply ready quickly.

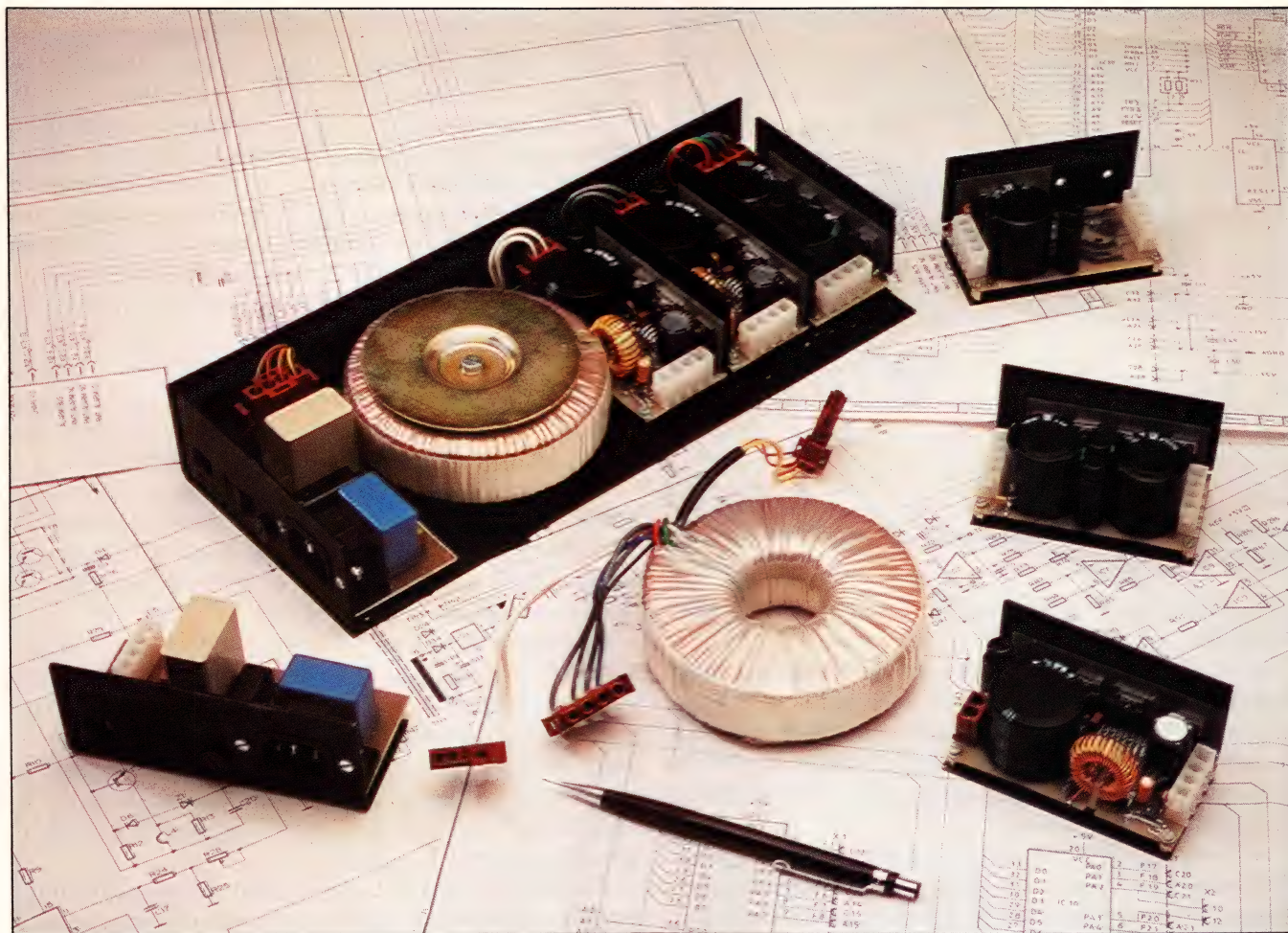
*Charles H Small, Associate Editor*

*Modular, user-configurable power supplies let you quickly assemble the exact combination of voltages and currents that your application requires.*

*Unfortunately, there are tradeoffs involved in using such supplies, and intermediate solutions do exist.*

A single, properly sized backplane can accommodate several different combinations of output modules and thereby serve across a range of related products. That way, your company has fewer types of power supplies to keep in stock and is able to order those fewer items in greater quantity. The power-supply maker,





*User-customizable multiple-output supply with a toroidal transformer (Ulveco Inc)*

too, enjoys a similar benefit: It needs to build and stock only modules instead of myriad standard supplies with various combinations of voltages and currents. This type of stockpiling can result in quicker delivery for the power-supply user.

A modular supply's flexibility obviously isn't advantageous solely in terms of production. You can exploit a user-configurable supply's flexibility and expandability in several ways. For example, upgrading a product might require squeezing 20 or 30% more power from the product's power supply to handle the upgraded circuitry. If the product contains a modular supply, you might be able to obtain the additional power simply by changing the modules within the supply, thus making it unnecessary to mechanically redesign the product to accommodate a larger power-supply enclosure.

But, appealing as the user-configurable power-supply concept is, only a handful of power-supply makers offer

modular, user-configurable supplies; a host of practical problems forestalls most power-supply manufacturers from entering this market. Many power-supply makers contacted by EDN stated that they had considered the modular approach but had rejected it for cost, size, and performance reasons.

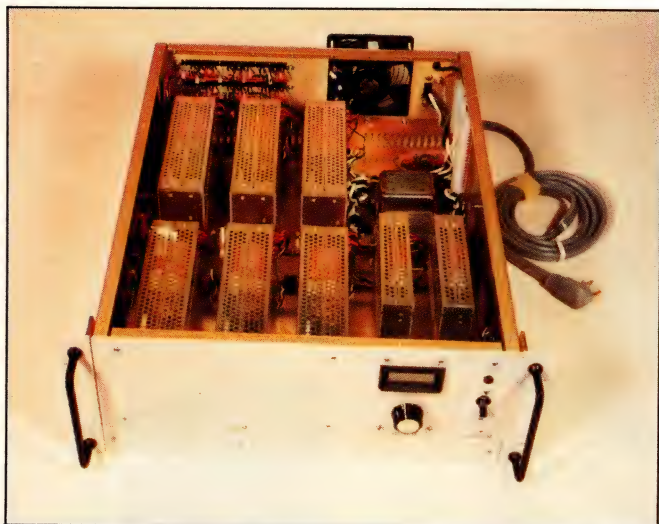
A user-configurable multiple-output supply may indeed cost more than a standard multiple-output version because a standard supply can share components among the various outputs' circuits, whereas a user-configurable supply cannot. For example, a standard supply can derive its auxiliary outputs from extra windings on the main output's transformer or inductor. A modular supply must have separate circuitry for each output. In a standard supply, power-handling components can share mechanical devices like heat sinks; in modular supplies, they cannot. In some applications, of course, the isolation and lack of cross regulation among



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*User-configurable supplies offer flexibility, fast turnaround time, easy expandability, and little or no waiting for agency certification.*

---



**Rack-mounted, multiple-output supply assembled from standard supplies (Kepco Inc)**

a modular supply's outputs might be an advantage that outweighs the disadvantage of extra cost.

Makers of user-configurable supplies admit that their products can cost 20% or more to manufacture than equivalent standard supplies. But they claim that because they make a higher volume of a smaller number of different units, their selling costs can be comparable to that of standard supplies.

A modular supply is often larger than its standard-supply counterpart because it has more components and also because the modular approach might not allow the supply's designer to pack the supply's components closely. Power-handling components tend to be large, and therefore a power-supply assembly presents the appearance of a very jagged skyline. A modular supply must allow enough room for several different assemblies to fit into a given space; a standard supply, which has one and only one configuration, can allow denser component packing.

Several power-supply manufacturers do actually make their power supplies in a modular fashion but do not let their customers assemble the modules. Instead they offer them as standard products. These companies agree that the modular approach does confer benefits in the form of cost savings, simplified stocking, and faster turnaround. But they believe that the final assembly of their modules is not compatible with a plug-in approach by their customers. Good power-supply design, they say, mandates short component-lead lengths and good power-handling connections, and so they prefer to solder components in directly and not use connectors.

If you do choose the user-configurable route, you might consider Powertec's Series 6. Models 6A, 6B, and 6C supply 600, 800, and 1000W, respectively, from 5×8×11-in. enclosures. Single-piece prices range from \$850 to \$1150, and delivery is stock to 10 weeks ARO.

Each supply has room for three auxiliary modules in addition to the main-output module; all modules are switching converters. You can choose from among 19 main-output modules. Each unit's main-output module provides 2 to 48V dc and a maximum of 150A (at 5V dc). Auxiliary modules come in nine single-output versions (2 to 48V); two dual-output versions ( $\pm 12$  and  $\pm 15$ V, which occupy two module locations); and a triple-output module (5V,  $\pm 12$ V). You can therefore configure the fan-cooled supplies to have as many as 10 outputs.

You can set the supplies' inputs for 92 to 132V ac or 180 to 264V ac in the field. The supplies also feature a full range of interface inputs and outputs: remote inhibit (high and low inputs) as well as input-power-failure and output-okay signals.

All power outputs are fully independent and floating. Further, you can parallel the main output with any auxiliary outputs that have the same voltage as the main. The outputs will current-share in proportion to each output's current rating. The units also feature overvoltage protection and overtemperature shutdown. They meet UL, CSA, IEC, and VDE safety specifications, including Class I SELV.

The architecture of Ulveco's Eureka line of modular supplies is strikingly different from Powertec's. The Powertec backplane provides high-voltage dc to the individual switching modules; Ulveco's modules are complete ac-to-dc linear and switching supplies. Further, whereas the Powertec supplies handle 600 to 1000W, the Ulveco supplies typically handle approximately 100W.

To configure a Eureka supply, you first select modules from among four switching-regulator modules and eight linear-regulator modules. The company has L-shaped frames that will accept two, three, or four modules. Next, you select a transformer that has the proper low-voltage ac taps for the modules you have selected. The company's toroidal transformers are listed as recognized components by most major safety agencies, including UL, CSA, and VDE. The transformers are available with 115, 230, or 115 to 230V ac inputs. Last, you select an input module with the line-cord adapter, on-off switch, and RFI filter you need.

In addition to input/output isolation, the toroidal



transformer contributes to the supplies' low profile; height and width for all chassis is 2×4.75 in. The 2-regulator chassis is 10.5 in. long, the 3-regulator chassis is 12.5 in. long, and the 4-regulator chassis is 14.5 in. long. A cover is optional.

The company offers four switching regulators that supply 5V at 4A, 12V at 4A, 15V at 4A, or 24V at 3A. The switching regulators feature a synchronizing output and a power-okay output. The linear regulators all supply 1.5A. They come in 5, 12, 15, and 24V single- and dual-output versions. Both types of regulators have overvoltage, overcurrent, and overtemperature protection and are short-circuit proof.

In 100-piece quantities, the switching regulators cost \$58.50, the single-output linear regulators are \$42.35, and the dual-output linear regulators sell for \$53.50.

The input modules add \$35 to \$46, and the L-frames run from \$8.10 to \$12.50. Transformers range in price from \$17.80 to \$38.10. The company claims that a typical 100W supply with four outputs costs about \$220.

Whereas the Powertec and Ulveco supplies suit common logic and analog applications, the Bertan Associates B-Hive is a user-configurable, high-voltage supply mainframe. The B-Hive can control as many as 32 of the company's high-voltage supplies. It will accept as many as 16 plug-in, high-voltage supplies directly. These plug-ins can supply either 0 to 3 kV at 3 mA or 0 to 7.5 kV at 1 mA (both positive and negative voltages). The unit can deliver 32 outputs at a maximum of 100 kV each, with power outputs as high as 250W each.

The B-Hive suits specialized ATE applications like the testing of CRTs, which require high voltages. It has

## Multiple-output-supply alternatives

Perhaps the most straightforward approach to the multiple-output problem is to use multiple supplies: You simply obtain a collection of single-output supplies that meets your requirements; several companies offer racks that hold a group of such supplies.

This multiple-supply approach offers quick design turnaround, easy expandability, and fast agency approval. It also gives you alternate-sourcing capability. The disadvantages are extra cost and size. In addition, you must be careful with power-line input filtering; if each supply has its own input filter, the aggregate leakage to ground of all the filters operating in parallel could exceed safety agencies' specs.

Of course, you can simply select a standard, multiple-output supply. This approach offers low cost, quick lead times (usually), simplified agency certification, and small size (compared with

implementations using several single-output units).

However, you might find, to your chagrin, that standard-supply catalogs have every conceivable combination of specs except the one you need (particularly if you leave power-supply selection for last). Moreover, lead times on such supplies aren't always short: Some manufacturers require 12 to 14 weeks to actually ramp up for production of their supposedly standard, off-the-shelf supplies, and your production department might not be able to tolerate such delays, particularly if it's adopting the just-in-time stocking of inventory that's becoming increasingly favored by the electronics industry.

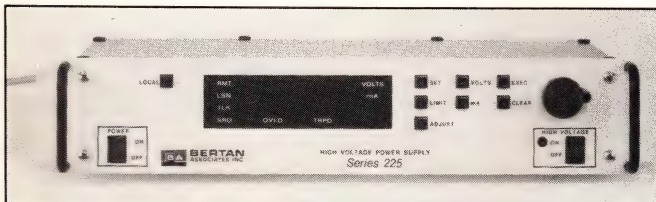
Custom-designed multiple-output supplies offer cost and size advantages—if your volume justifies their use or if your application demands them. Possibly to meet mechanical, rather than electrical, requirements, you

might be forced to choose a custom supply if the supply's design gets left until the last phases of a project and you find that you must cram the supply into a left-over, oddly shaped location.

If you build your own custom supply rather than employ the services of a power-supply maker, you can guarantee a certain level of quality control. Indeed, the number of in-house-manufactured power supplies exceeds that of third-party power-supply companies by a considerable margin. Even for the small fraction of supplies made by third-party power-supply makers, most of those produced in high volume are custom supplies made for a particular customer. But whether you build them yourself or have a power-supply manufacturer build them, custom supplies entail long lead times for design, long delays for (and a considerable hassle with) agency certification, and lack of alternate sources.



*Several companies offer an intermediate solution: something that's not quite a user-configurable supply and not quite a custom supply.*

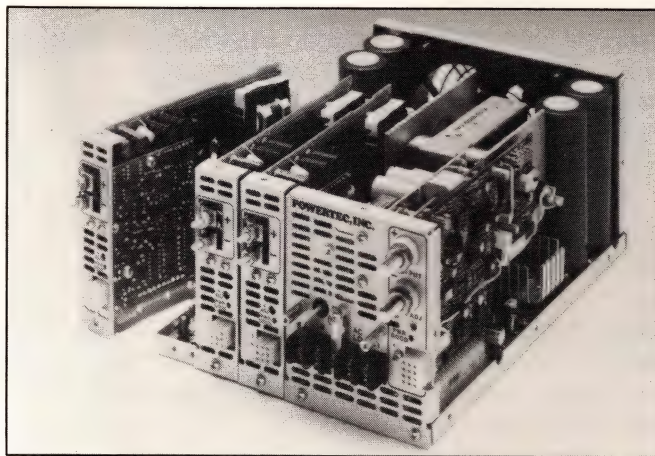


**User-configurable, high-voltage ATE supply (Bertan Associates)**

built-in IEEE-488 and RS-232C interfaces. You can set up the unit with a simple CRT terminal or control it with an IEEE-488-compatible computer. The unit's optional CAMAC interface hints at its other uses in physics laboratories for powering particle detectors.

The plug-ins provide line regulation of 0.001%, load regulation of 0.005%, and 100-mV max ripple at full load. A fast-trip circuit provides arc protection. When the unit detects a high-voltage arc, it automatically removes the drive to the offending high-voltage generator within 50  $\mu$ sec. In addition, the supplies have overvoltage and overcurrent protection. The B-Hive costs \$3780 to \$3860, depending on options; plug-in supplies cost \$820 to \$930 each; and plug-in supply controllers cost \$575.

The Icecube power-supply subassemblies from Powercube also suit a specialized application: They are military-grade supplies. The series comprises input, regulator, and output modules, all enclosed in military-



**Modular, multiple-output switching supply (Powertec Inc)**

grade packages that you can link together to form a supply that suits your application. The company claims that the Icecube Series is the first standard-supply line built under the Navy's guideline for power-supply design (NAVMAT publication P-4855-1). The units operate over the military temperature range of  $-55$  to  $+125^{\circ}\text{C}$  with no derating.

If you're not convinced that a user-configurable multiple-output supply fits your plans, several power-supply companies offer an intermediate solution—not quite a user-configurable supply and not quite a custom-designed supply. Lorain, Lambda, and Kepco, for example, will assemble and wire your choice of their standard-supply offerings into a standard 19-in. rack-mounted cabinet.

Kepco furnishes design engineers with a kit of full-size power-supply templates that correspond to the footprints of the company's standard supplies. You select the supplies you need for your application, and with the aid of the templates, lay out a floor plan for the supplies in a standard rack-mounted cabinet.

If you want, you can also specify various front- and rear-panel configurations from among standard fractional-panel subassemblies. The front-panel subassemblies hold such devices as circuit breakers, voltage adjustments, status indicators, voltage readouts, and test points. The rear panels hold terminal strips, fans, and line-cord adapters. After you send in your design, Kepco will assemble and test the unit. **EDN**

## For more information . . .

For more information on the power supplies described in this article, circle the appropriate numbers on the Information Retrieval Service card or contact the following manufacturers directly.

**Bertan Associates Inc**  
121 New South Rd  
Hicksville, NY 11801  
(516) 433-3110  
Circle No 684

**Kepco Inc**  
131-38 Sanford Ave  
Flushing, NY 11352  
(718) 461-7000  
Circle No 685

**Lambda Electronics**  
515 Broad Hollow Rd  
Melville, NY 11747  
(516) 694-4200  
Circle No 686

**Lorain Products**  
1122 F St  
Lorain, OH 44052  
(216) 288-1122  
Circle No 687

**Powercube Inc**  
8 Suburban Park Dr  
Billerica, MA 01821  
(617) 667-9500  
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**Powertec Inc**  
20550 Nordhoff St  
Chatsworth, CA 91311  
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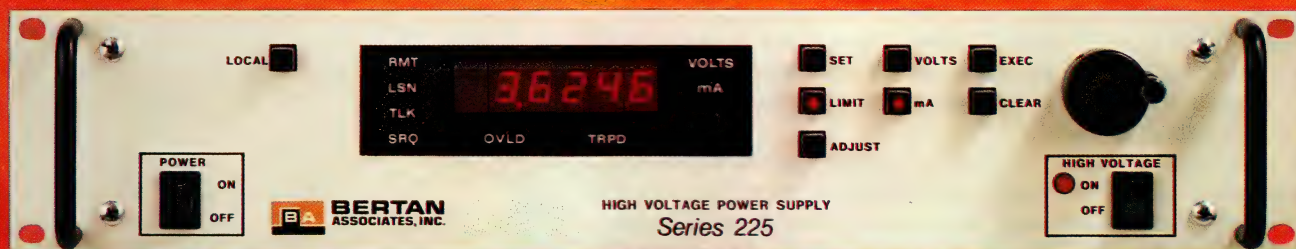
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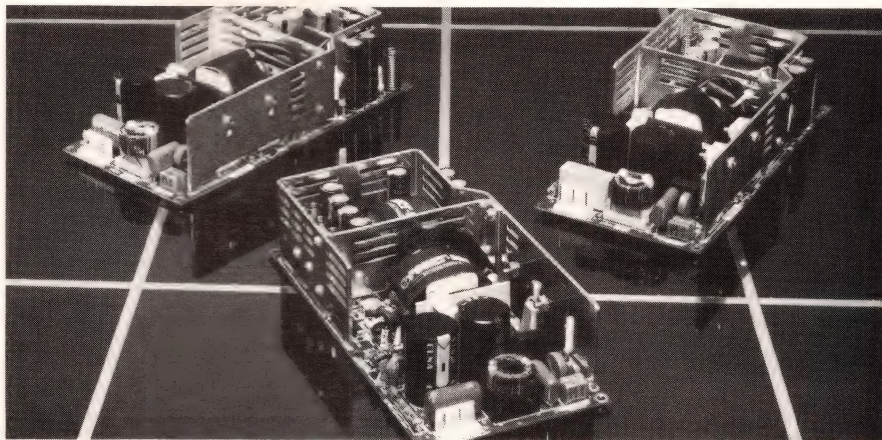
# Power Sources

## Miniature card-mounted power supplies measure 8×4×2.1 in., offer four outputs

The SPL175 International Series offers seven output combinations of five voltages: 5, 12, 24, -5, and -12V. Output currents are available to 1A at -12 and -5V, 3A at 24V, 5A at 12V, and 20A at 5V. Depending on the unit, line regulation varies from 0.1 to 0.3%, and load regulation varies from 1 to 3%. All units maintain regulation to 90 and 180V ac at full load. Output noise and ripple are 0.3% rms and 1% p-p max, respectively.

The 4-output supplies spec efficiencies of 65 to 75% according to the load distribution among outputs. These efficiencies are measured at full load and nominal ac input voltage. Holdup time ranges from 20 msec at full load and nominal input voltage to 40 msec at 50% rated load.

The series limits inrush current to 17A pk at 230V ac inputs. Operating temperature spans 0 to 50°C at



full-rated output power. Only convection cooling is required where unrestricted airflow is present, provided that output power is less than 175W.

All supplies in the series meet or exceed the following safety agency requirements for dielectric withstand voltage, insulation, and clearance: UL 1012 and 478; CSA 22.2; VDE 0730, 0804, 0806, and 0805

(proposed); IEC 380 and 435; and CEE-10. They are UL recognized to UL 478 and CSA certified to CSA 22.2. Certification to previously listed VDE and IEC requirements by TUV Rhineland is pending. The supplies are priced at \$145 (1000).

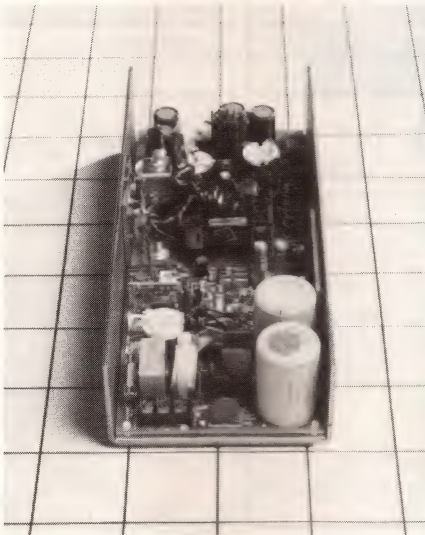
**Power One Inc, 740 Calle Plano, Camarillo, CA 93010. Phone (805) 987-8741.**

Circle No 752

## Switching power supplies generate 400W and specify MTBF of 100,000 hours

These 400W, triple-output power supplies, the MDX-403 1212R and the MDX-403 1205R, specify line and load regulation of  $\pm 1\%$ . Output 2 adheres to a  $\pm 5\%$  regulation band determined by the 5V terminal voltage. Output 1 offers as much as 70A at 5V; output 2 provides 10A at 12V (Model 1212R) or -5.2V (Model 1205R); and output 3 delivers a maximum of 2A at 12V.

AC-input range can be either 90 to 130V ac or 180 to 260V ac; holdup time is 16 msec min at nominal line voltage and full load. Combined output must not exceed 400W. The switchers' efficiency is 75% typ, and



MTBF is a minimum of 100,000 hours. Operating temperature ranges from 0 to 50°C (full rating); 30-cfm moving air through the 11.5×5×2.5-in. units is necessary for cooling.

The series meets UL 478, IEC 435, and VDE 0806 class 1 SELV safety standards. In addition, each supply has a built-in RFI filter that meets VDE 0871 and FCC class A standards. \$379 (100).

**Todd Products Corp, 50 Emjay Blvd, Brentwood, NY 11717. Phone (800) 223-8633; in NY, (516) 231-3366.**

Circle No 753



# Power Sources

## Single-output supplies offer 3.5W/in<sup>3</sup> and choice of user-selectable inputs

Providing as much as 3.5W/in<sup>3</sup> for as little as \$0.69/W, LFS Series single-output power supplies feature output voltages of 2 to 48V and current outputs to 9A. All models offer customer-selectable dual inputs (95 to 132V ac or 187 to 265V ac, 47 to 440 Hz) and 0.1% load and line regulation.

The supplies limit turn-on inrush current to less than 40A pk and spec isolation of 3750V rms. For the 2, 5, and 6V models, ripple and noise is 15 mV rms, 75 mV p-p; for the 12 to 28V models, it's 20 mV rms, 150 mV p-p; and for the 48V models, it's 35 mV rms, 200 mV p-p.

Ambient operating temperature is specified as 0 to 60°C; derating is



required above 40°C and below -10°C. The single-output supplies are designed to meet UL 478; CSA 22.2, 143, and 154; VDE 0806; and IEC 380, and they are currently undergoing evaluation for these agency approvals.

By taking advantage of the company's monolithic PWM control circuit and advances in surface-mount technology, the series achieves a 40% reduction in parts, a 50% reduction in volume, and an attendant 25% reduction in cost. Prices start at \$189 (1000).

**Lambda Electronics, 515 Broad Hollow Road, Melville, NY 11747. Phone (516) 694-4200.**

Circle No 751

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CIRCLE NO 137

EDN December 11, 1986



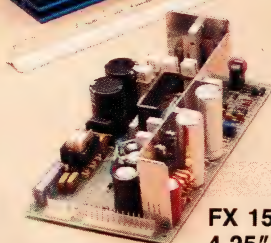
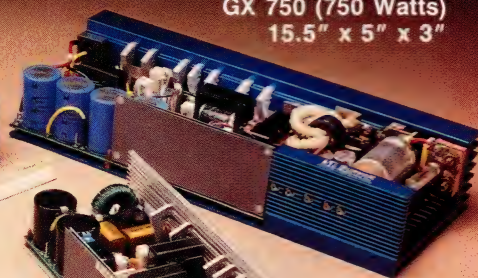
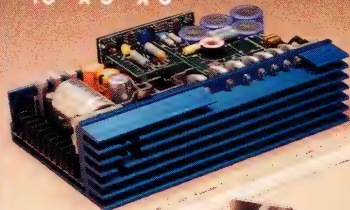
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New 250 & 350 Watt HX Series  
Power Supplies

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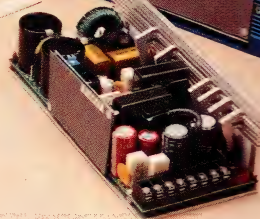
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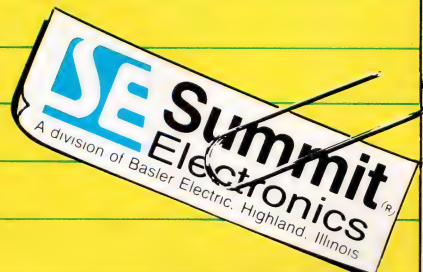
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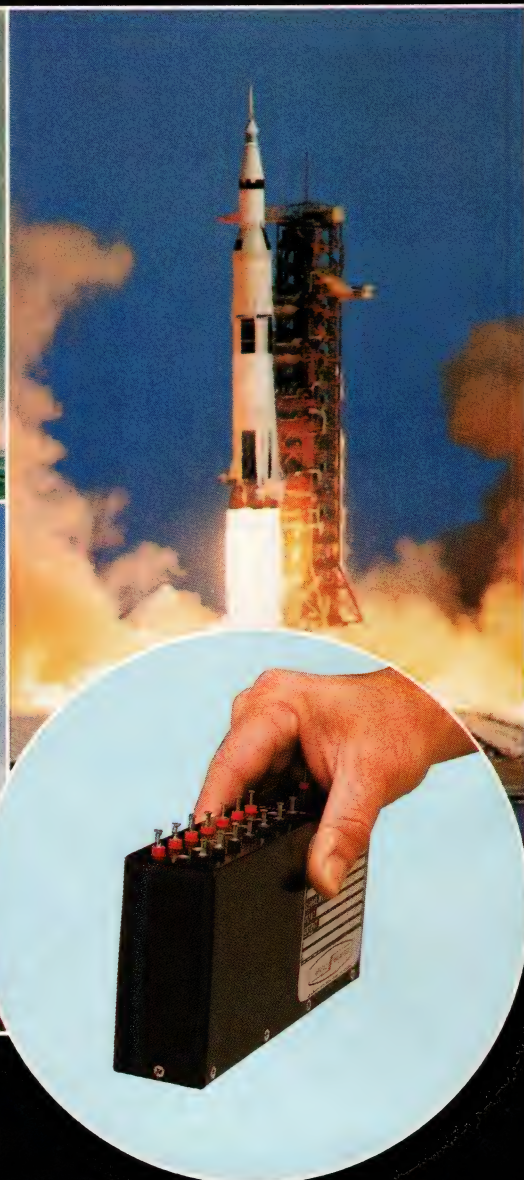
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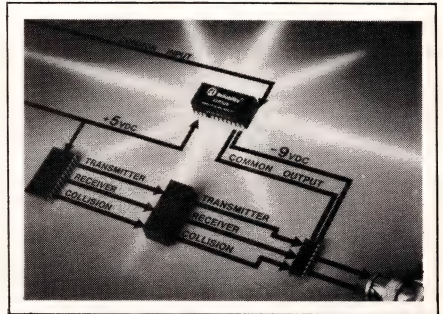
1×1.38×0.7 in. and weigh 20g. Operating range is 0 to 70°C. Each device costs \$6.65 (1000); prototypes are available three to five weeks ARO, and production quantities are available six to eight weeks ARO. The basic PWM circuit can accommodate various input/output configurations with output power to 3W. Consult the factory for NRE costs and delivery for any custom requirements.

**Endicott Research Group Inc,**  
Box 269, Endicott, NY 13760.  
Phone (607) 754-9187. TWX 510-252-0155.

Circle No 756

## DC/DC CONVERTERS

LAN-PAC Series dc/dc converters are intended to provide power and isolation for LAN transceiver chips available from such manufacturers as Advanced Micro Devices, Nation-



al Semiconductor, and Intel. The converters operate from inputs of 5 and 12V. In addition, wide-input models are available that utilize inputs from 10.2 to 15.75V dc and that provide input/output isolation of 500 and 2500V dc. \$18 (1000).

**Reliability Inc, Box 218370,**  
Houston, TX 77218. Phone (713)  
492-0550. TLX 4620383.

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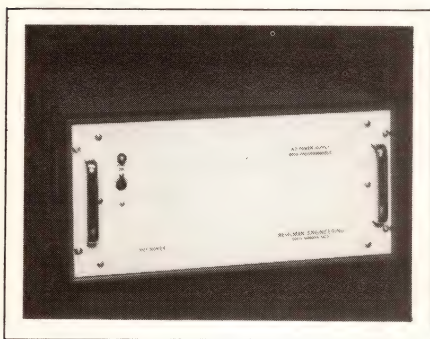
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# Power Sources

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The series comes with current ratings from 7.5 to 30A and power



from 750 to 3000 VA. Input voltage is specified as 115 or 230V ac  $\pm 10\%$  single phase for models with 750-, 1000-, and 1500-VA outputs, and 208 or 230V ac  $\pm 10\%$  three phase for models with 2000- and 3000-VA outputs. Prices start at \$4675.

**Behlman Engineering, 1142 Mark Ave, Carpinteria, CA 93013. Phone (805) 684-8311.**

Circle No 757

## COMPACT SWITCHER

RC Series 1-MHz dc/dc converters are aimed at military and aerospace applications. The converters have the same pinout as their predecessors, the MV Series, and pack 100W into 4.5 in<sup>3</sup>, yielding 22W/in<sup>3</sup>. Input ranges for both 28 and 270V dc buses meet MIL-STD-704D and MIL-STD-1275A. Priced from \$850 to \$900, the converter will be available in prototype quantities first



quarter '87, and in production quantities second quarter '87.

**Power Technology Group, Inland Motor Div, 4020 E Inland Road, Sierra Vista, AZ 85635. Phone (602) 459-1150. TWX 910-973-9869.**

Circle No 755

## NiCd BATTERIES

This company's line of power products now includes two more NiCd devices, the N-120TA and the



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For detailed product specifications and to arrange for an engineering test sample, write to The Superior Electric Company, 383 Middle Street, Bristol, CT 06010. For immediate action, call 203/582-9561.

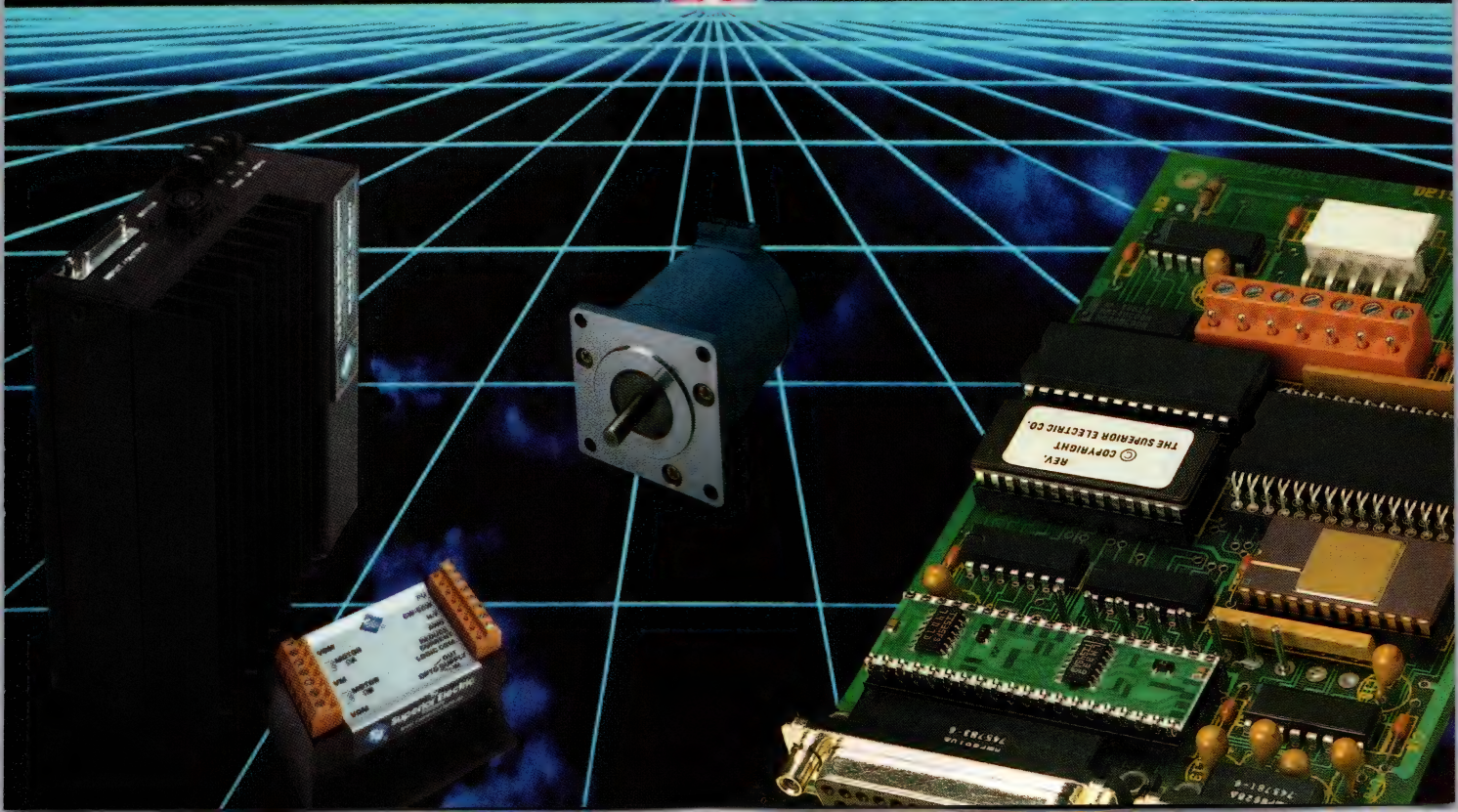
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# Power Sources

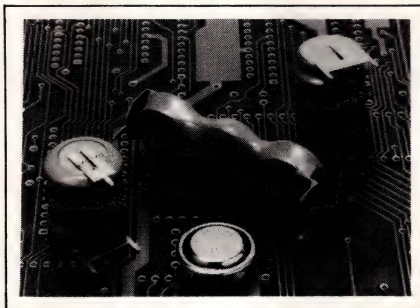
N-6PT. According to the manufacturer, the 0.3-in. diameter of the N-120TA makes it one of the slimmest sealed-cylinder NiCd units. The N-6PT consists of six N-120TA devices and provides 120-mAhr capacity in a 006P-type package. The N-120TA is rated at 1.2V and also has a 120-mAhr capacity. The N-6PT is rated at 7.2V. The standard charging current is 12 mA with a corresponding charge time of 14 to 16 hours. The N-120TA costs \$1.90, and the N-6PT sells for \$7.27 (100).

**Sanyo Electric Inc, 200 Riser Rd, Little Ferry, NJ 07643. Phone (201) 641-2333.**

Circle No 758

## NiCd CELLS

The 40 DKT is a rechargeable, 40-mAhr, 1.2V button cell intended for use at temperatures to 65°C. You can use several of the cells,



which feature mass-plate construction, and assemble them into batteries with ratings to 7.2V.

The cell is specified to remain at or above rated voltage for about eight hours when discharging at a 4-mA rate. It can recharge at rates as low as C/100, and continuous trickle charging specs are as follows: six years at 10 to 40°C, three years at 40 to 55°C, and one year at 55 to 65°C. The cell's dimensions are 0.61×0.24 in., and it weighs 3.4g. \$1.25 (1000). Delivery, six to eight weeks ARO.

**Varta Batteries Inc, 300 Executive Blvd, Elmsford, NY 10523. Phone (914) 592-2500.**

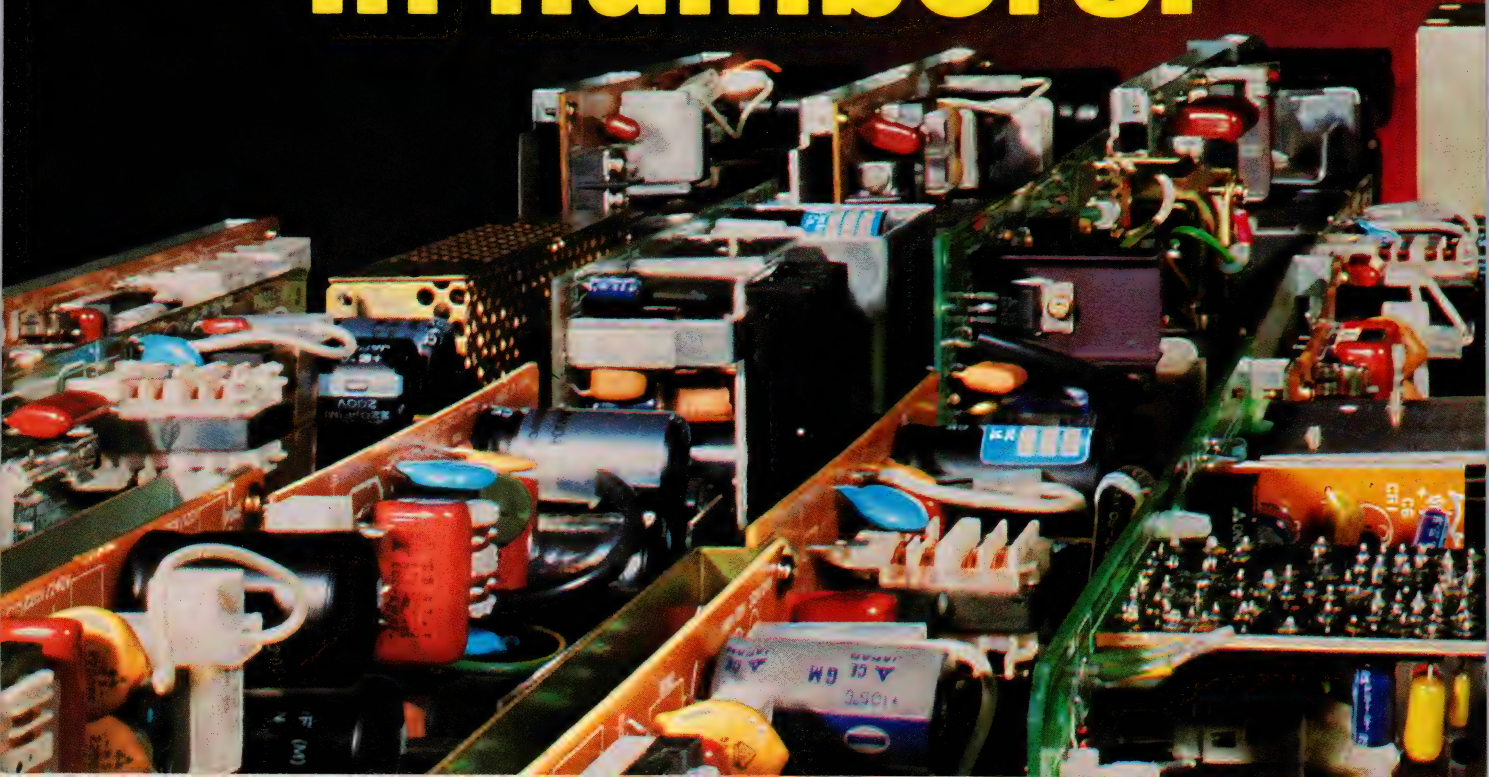
Circle No 759



## SEALED BATTERIES

The SBS family of sealed lead-acid batteries comprises four models, the SBS 30, 40, 110, and 300, which provide 26, 35, 100, and 300 Ahr, respectively, at discharge rates of C/20. At high discharge rates (C/1), the respective batteries' capacity is

# Power in numbers.





# Power Sources

18, 25, and 80 Ahr.

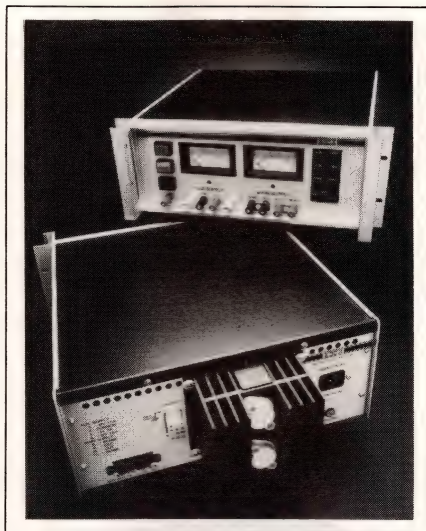
Recommended storage temperature is  $-65$  to  $+60^{\circ}\text{C}$ ; for charging and discharging alike, the company recommends temperatures of  $-40$  to  $+60^{\circ}\text{C}$ . Constant potential charging is recommended, but you can employ float charging for UPSs and other standby applications. Typical life for a battery using a float-charging scheme is 10 years at  $25^{\circ}\text{C}$ ; using cyclic charging, its life is 200 to 2000 cycles. The SBS 30 is priced at \$88.

**Gates Energy Products Inc., Box 5887, Denver, CO 80217. Phone (303) 744-4806.**

Circle No 760

## LAB SUPPLY

Model PS-101 features the following outputs:  $+12$ ,  $-12$ , and  $+5\text{V}$  dc, and a variable output that ranges from 0 to  $20.47\text{V}$  dc. You can control the



variable output via the IEEE-488 interface, or you can use front-panel keys to raise or lower the voltage in  $0.5$  or  $0.01\text{V}$  increments. Remote sensing allows a  $600\text{-mV}$  drop in external connections without affecting regulation at the load.

The main supply is regulated to

$\pm 0.1\%$  or  $5\text{ mV}$ , whichever is greater. Current output is limited to  $2.7\text{A}$ . The  $-12\text{V}$  output provides  $1.5\text{A}$ ; the  $5\text{V}$  output,  $3\text{A}$ ; and the  $12\text{V}$  output,  $1.5\text{A}$  ( $\pm 5\%$ ). Input to the supply is  $105$  or  $130\text{V}$  ac. \$1395.

**Interactive Technologies Inc., 2266 N Second St, North St Paul, MN 55109. Phone (612) 777-2690.**

Circle No 761

## LITHIUM MODULES

Recognized to UL 1642, this series of lithium power modules features capacities spanning 125 to  $1000\text{ mAhr}$  for user-replaceable applications. The modules specify a self-discharge rate of less than  $1\%/ \text{year}$  at  $25^{\circ}\text{C}$ . Operating-temperature range is  $-40$  to  $+70^{\circ}\text{C}$ . Nominal voltage is  $3.0\text{V}$ ; operating voltage is  $2.7$  to  $3.0\text{V}$ . Modules with  $250$ -,  $500$ -, and  $1000\text{-mAhr}$  capacities come in packages of  $1.2 \times 1.2 \times 0.4$

## Panasonic® Switching Power Supplies

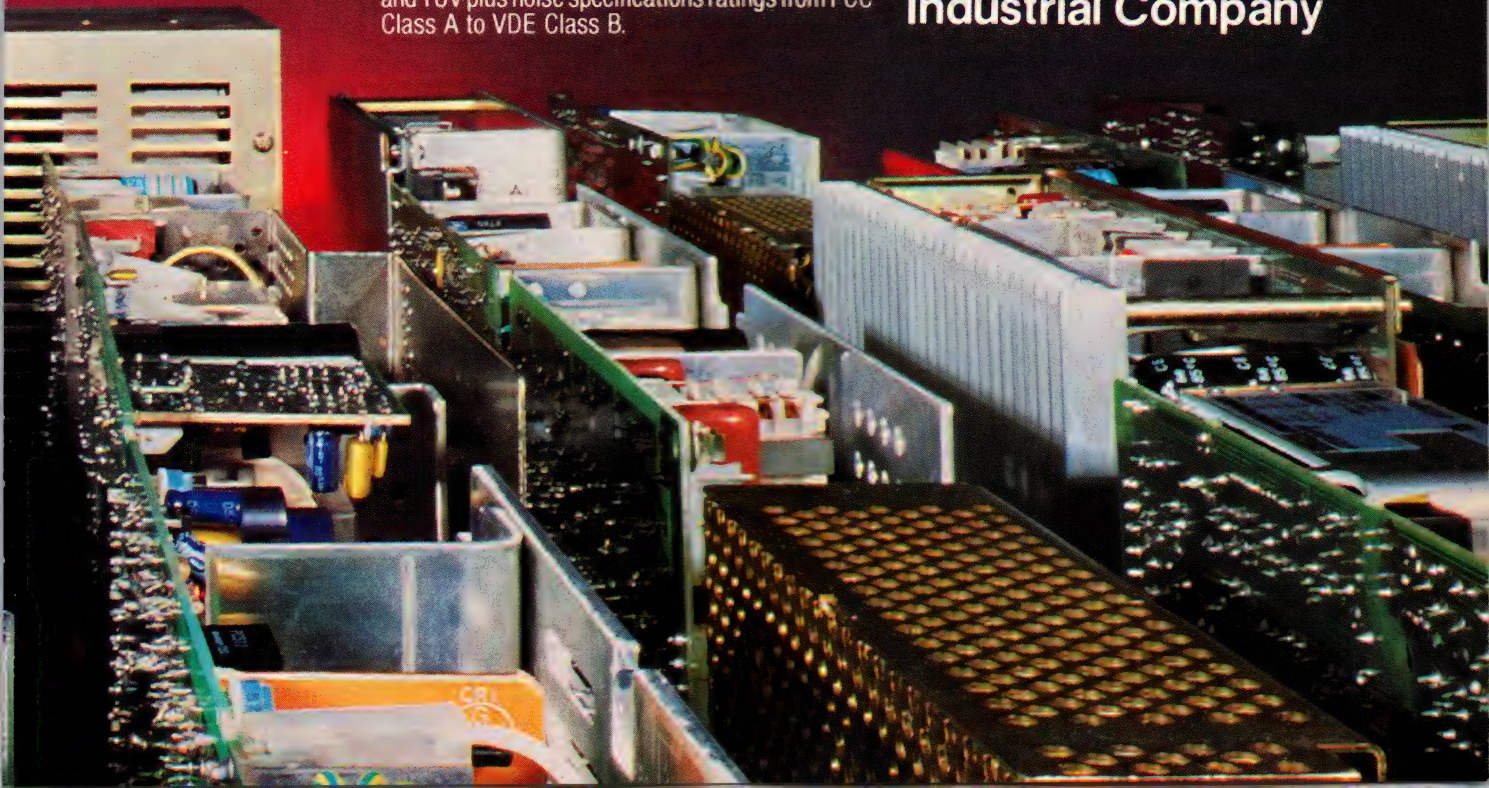
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Of course, Panasonic switching power supplies meet the necessary safety approvals of UL, CSA and TUV plus noise specifications ratings from FCC Class A to VDE Class B.

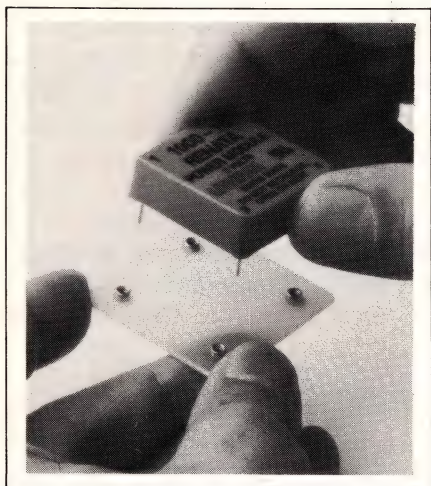
So, now that you've got our number, get the rest of the story. Panasonic Industrial Company, Computer Components Division, One Panasonic Way, Secaucus, NJ 07094. (201) 392-4290.

## Panasonic Industrial Company





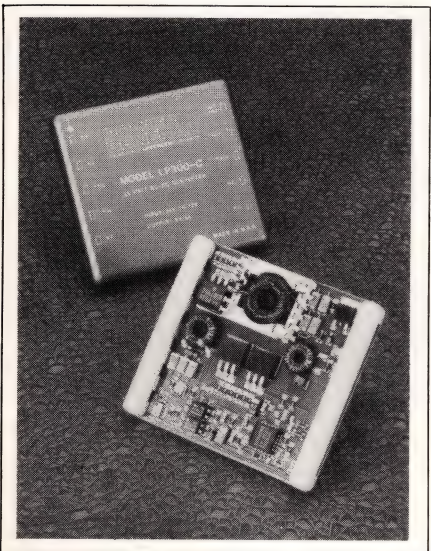
# Power Sources



in.; 125- and 175-mAhr modules come in 0.9×0.9×0.31-in. packages. All modules are hermetically sealed and wave solderable. \$3 (OEM qty).

**International Power Sources Inc., 10 Cochituate St., Suite 6, Natick, MA 01760. Phone (617) 651-1818. TWX 510-100-3630.**

Circle No 762



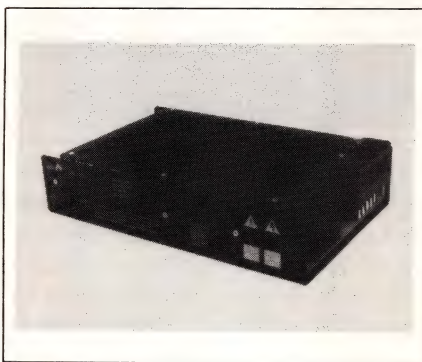
## DC/DC CONVERTERS

The LP-300 Series comprises 21 25W dc/dc converters offering single, dual, or triple outputs. Input voltage varies from 9 to 18V dc (12V nominal), 18 to 36V dc (24V nominal), and 36 to 72V dc (48V nominal). Single-output models have 5, 12, or 15V outputs; dual-output models have ±12 or ±15V outputs; and triple-output models have 5 and ±12V or 5 and ±15V outputs.

The 500-kHz switchers operate at 80% efficiency over 0 to 70°C. Storage temperature is -25 to +100°C. The modules measure 3×2.75×0.375 in., weigh 2.75 oz., and cost \$199 to \$209. Delivery, stock to six weeks ARO.

**Power General, 152 Will Dr., Canton, MA 02021. Phone (617) 828-6216. TWX 710-348-0200.**

Circle No 763



## 200W UPS

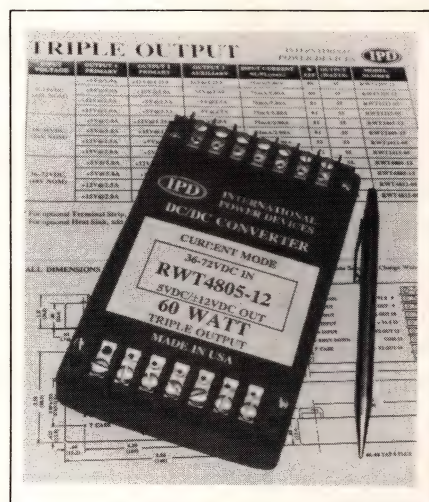
The DIC200 switch-mode power supply accepts input from either ac or dc sources, and its built-in trickle charger maintains a backup battery in a fully charged state. In the event of a power interruption, a 48V, 2.5-Ahr battery will maintain all three outputs within specification for 12 minutes under full load. The UPS has three outputs: Output 1 delivers 5V at 4 to 25A; outputs 2 and 3 each provide 12V to 4A. Load and line regulation are ±2%, and input voltage is 110 or 220V ac. The supply costs \$500.

**Bay Components Inc., Box 6638, Annapolis, MD 21401. Phone (301) 266-6767. TLX 510-600-7370.**

Circle No 764

## 55W CONVERTERS

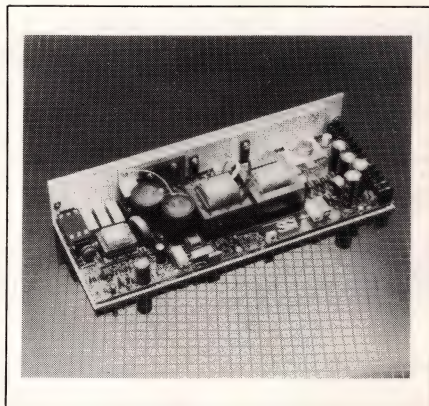
The RWT Series triple-output current-mode-control converters specify no minimum output loading requirement. Input ranges are 9 to 18V, 18 to 36V, and 36 to 72V, and various combinations of ±5, ±12, and ±15V outputs are available. Load regulation is ±2%; line regulation is ±1%. They operate to a



unit-case temperature of 85°C max; storage-temperature range is -55 to +105°C. The series measures 3.5×5.5×0.91 in. and costs \$210.

**International Power Devices Inc., 155 N Beacon St., Brighton, MA 02135. Phone (617) 782-3331.**

Circle No 765



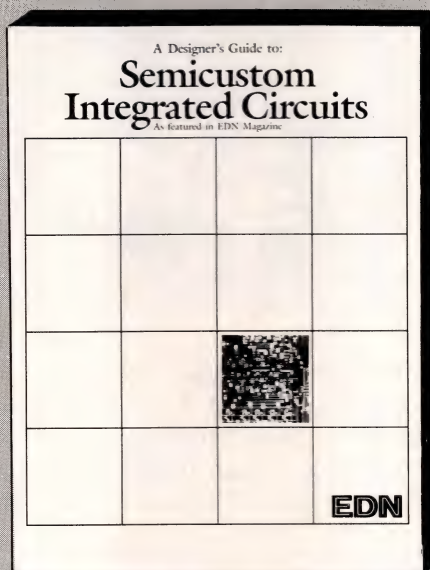
## HARD-DISK SUPPLY

The SQV350, a quad-output, 350W supply, is designed specifically for hard-disk applications and produces enough power for two 8-in. or eight 5¼-in. drives. Output voltages and currents are as follows: 5V at 10A (main output); 12 or 24V at 10A (16A pk) (auxiliary #1); 5, 12, or 24V at 5A (7A peak) (auxiliary #2 and #3).

The supply meets specifications for safety isolation and EMI/RFI emissions, including VDE 0806, 0730, and 0871 level A; IEC 380 and 435; British Telecom TG2 and TG26; UL 478; CSA 22.2; and FCC level A.



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# Power Sources

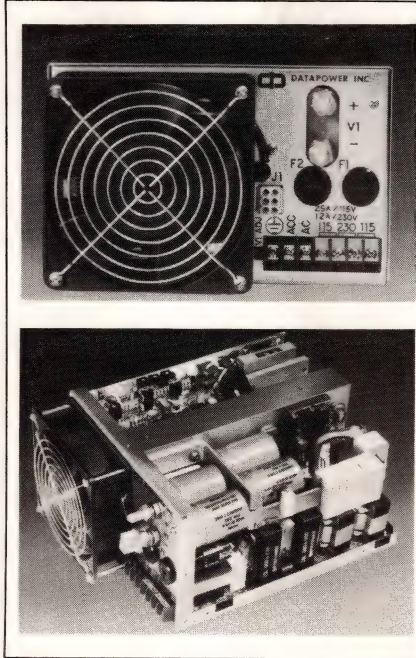
It receives a 24-hour burn-in prior to shipment and is priced at \$251 (100). Delivery, stock to six weeks ARO.

**Switching Systems International, 1827 N Case St, Orange, CA 92665. Phone (714) 921-1153.**

Circle No 766

## 200W SWITCHER

The DP line of switching power supplies provides output voltages of 2 to 48V dc at currents to 460A. You can choose from 750, 1000, 1500, or 2000W models. The supplies offer input ranges of 90 to 132V ac or 182 to 264V ac, 47 to 63 Hz, and include brownout protection down to 80 and 160V ac, respectively. An EMI line filter, which is optional, meets FCC 20780, part 15, or VDE 0871/6.78. Line regulation is  $\pm 0.2\%$  at 90 to 132V ac, and load regulation is  $\pm 0.4\%$  for a 0 to 100% load change. Noise and ripple is 1% or 50 mV p-p,



whichever is greater. The series operates from 0 to 70°C, at full output at 50°C, with derating to 70% at 70°C. Prices range from \$650 for the 750W model to \$1500 for the 2000W

model.

**Data Power Inc, Dept HPS, 3328 W First St, Santa Ana, CA 92703. Phone (714) 775-2000.**

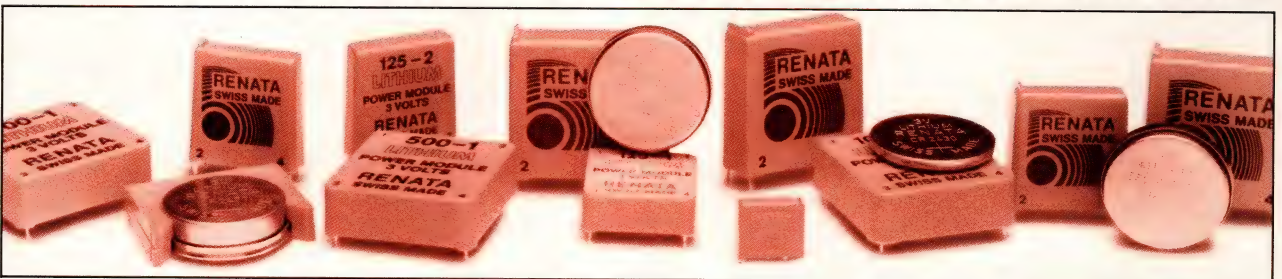
Circle No 767

## DC/DC CONVERTERS

The SA and SB Series isolated dc/dc converters, furnish power densities to 10W/in<sup>3</sup>. These pc-board-mountable converters utilize hybrid technology and a 200-kHz switching frequency to pack as much as 30W in their respective packages, which measure 2×2×0.43 and 3×3×0.43 in. The units' height make them suitable for Eurocard applications. Single- and multiple-output configurations are available, all of which operate from 35 to 63V dc inputs. Input/output isolation is 500V dc. \$69 to \$125 (OEM qty). Prototypes are available for immediate delivery; production quantities, 8 to 10 weeks ARO.

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# Power Sources

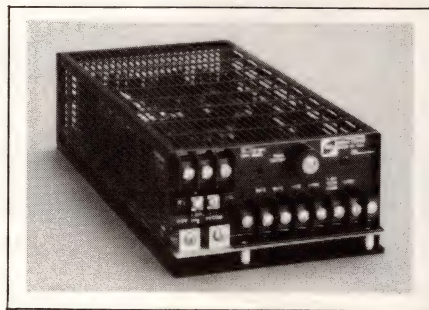
**International Power Sources Inc, 10 Cochituate Street, Suite 6, Natick, MA 01760. Phone (617) 651-1818. TWX 510-100-3630.**

Circle No 768

## 200W CONVERTER

The Model 2410 dc/dc converter offers three outputs and is designed

for use with 24 and 28V batteries. Actual input range is 19 to 32V dc. The 200W converter delivers 5V at 20A,  $\pm 12V$  at 4A, and  $-5V$  at 0.5A. All outputs are current limited and have continuous overload and short-circuit protection, as well as over-temperature and self-recovering overvoltage protection. No minimum load is required. Package size



is 2.7x5.25x11 in. The unit costs \$495.

**RO Associates Inc, Box 61419, Sunnyvale, CA 94088. Phone (408) 744-1450.**

Circle No 769

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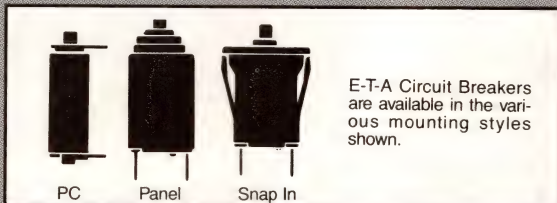
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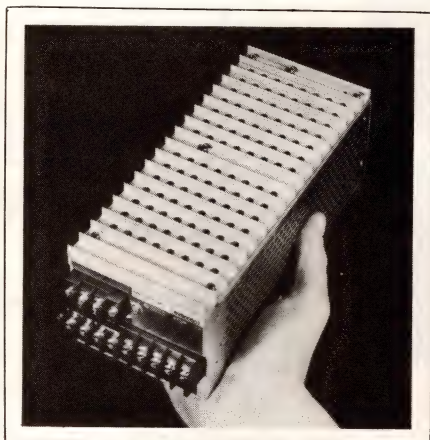
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## 300-kHz SWITCHERS

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**Kepeco Inc, 131-38 Sanford Ave, Flushing, NY 11352. Phone (718) 461-7000.**

Circle No 773

## DC/DC CONVERTER

Capable of delivering 750 mW, the NM0505i, NM1212i, and NM1515i miniature dc/dc converters produce outputs of  $\pm 5$ ,  $\pm 12$ , and  $\pm 15V$ , re-



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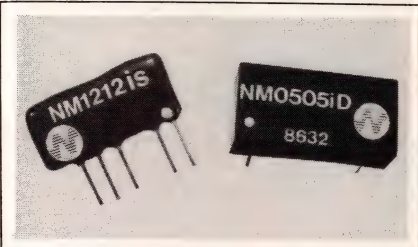
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## ALMOND INSTRUMENTS

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## Power Sources



spectively, from a 5V supply. The units are available in SIPs or DIPs with power densities of 750 mW/cm<sup>2</sup> and 500 mW/cm<sup>2</sup>, respectively. The SIP version occupies 0.18 in<sup>2</sup> of pc-board area and stands 0.37 in. high and the DIP version occupies 0.32 in<sup>2</sup> and stands 0.28 in. high. The input-to-output isolation is 500V dc and the converters operate without any derating over a temperature range of -25 to +80°C. £9.50 (1000).

**Newport Components Ltd, 134 Tanners Dr, Blakelands North, Milton Keynes, MK14 5BP, UK.**  
Phone (0908) 615232. TLX 825621.

Circle No 774

## DC/DC CONVERTERS

Single-output versions of MMP-90000 Series switch-mode dc/dc converters provide outputs of 12V at 2.5A or 15V at 1.6A. Triple-output versions are available with outputs of 5V at 3.8A and either  $\pm 12V$  at 250 mA or  $\pm 15V$  at 200 mA. The  $\pm 12V$  and  $\pm 15V$  outputs are semi-regulated; the output voltage depends to some extent on the loading of the 5V and  $\pm 12V$  or  $\pm 15V$  outputs—for example,  $\pm 1.5V$  typ for a load change on the  $\pm 12V$  outputs from 50 to 250 mA.

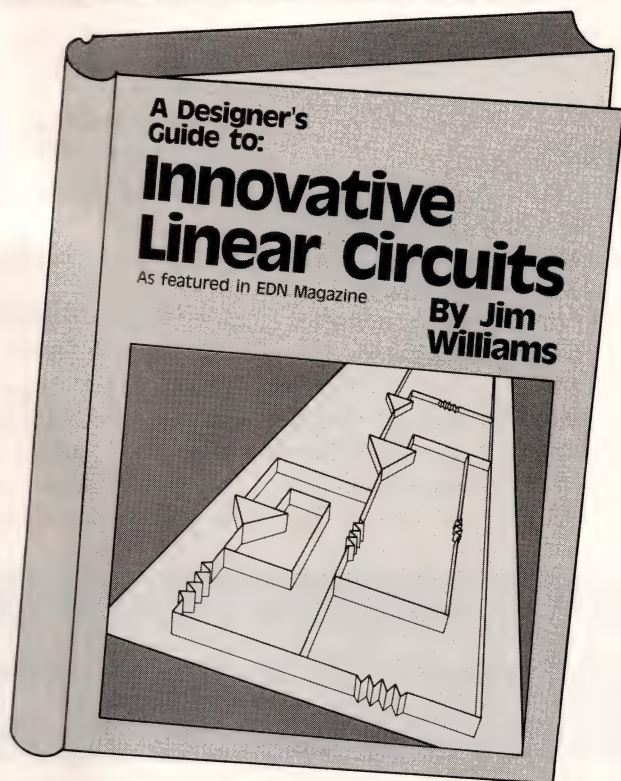
Converters rated for nominal 24V inputs operate from 19 to 35V dc, and versions rated for nominal 48V inputs operate from 39 to 64V dc. The converters feature a switching frequency of 300 kHz, undervoltage lockout, output short-circuit protection, and internal output power limiting. You can parallel the converters to produce higher load currents. They are housed in 68×76×18.2-mm packages for pc-board mounting, and they operate over 0 to 55°C at



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**Marconi Electronic Devices Inc, 80 Smith St, Farmingdale, NY 11735. Phone (516) 420-8378.**

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## BATTERY

The 40-DKT battery is a sealed, rechargeable, 1.2V NiCd button cell with a nominal capacity of 40 mAh at room temperature. The battery is specified for use over 10 to 65°C during charge periods and -10 to +65°C during discharge or storage. Recommended continuous charging currents are 0.4 mA between 10 and 40°C, 0.8 mA between 40 and 55°C, and 1.2 mA between 55 and 65°C.

The corresponding battery lifetimes for continuous charging over these temperature ranges are six years, three years, and one year. Self discharge is 20% in 28 days at room temperature. The battery measures 15.5 mm in diameter and 6 mm in height. DM 2.90 (OEM qty).

**Varta Batterie AG, Am Leineufer 51, 3000 Hannover 21, West Germany. Phone (0511) 79031. TLX 921175.**

Circle No 775

**Varta Batteries Inc, 300 Executive Blvd, Elmsford, NY 10523. Phone (914) 592-2500.**

Circle No 776

## PROGRAMMABLE SUPPLY

The Model 5080 programmable power supply operates in constant-voltage or constant-current mode, and it has output sink and source capability. You can select voltage outputs in the range 0 to 30V with



10-mV resolution and current outputs in the range 0 to 200 mA with 0.1-mA resolution. The voltage-output accuracy is 10 mV or 0.075% of output voltage, whichever is greater, and the current-output accuracy is 0.1 mA when the output is sourcing current, or 1 mA when sinking current. Ripple and noise amounts to 3 mV or 0.1 mA rms.

You can control the power supply via its front-panel keyboard or via its integral IEEE-488 interface. The IEEE-488 interface has listener, talker, and service-request capabilities for remote programming and interrogation of power-supply status. You can also program limit values on the output. The unit operates from 100 to 130V or 200 to 260V, 48- to 63-Hz line supplies over 0 to 50°C. £2000.

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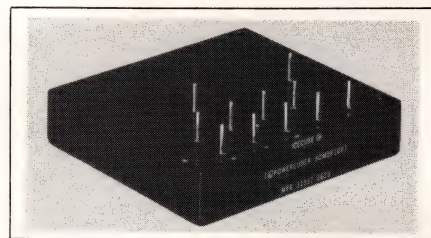


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## DC/DC CONVERTERS

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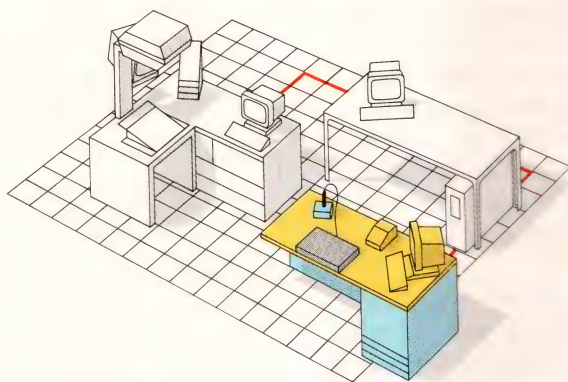
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overvoltage zener protection. The following outputs are available: 5, 12, 15, 24, and 28V. Aimed at military applications, the converters are rated for operation over  $-55$  to  $+100^{\circ}\text{C}$ . \$950. Delivery, 10 to 12 weeks ARO.

**Powercube, 8 Suburban Park Dr, Billerica, MA 01821. Phone (617) 667-9500.**

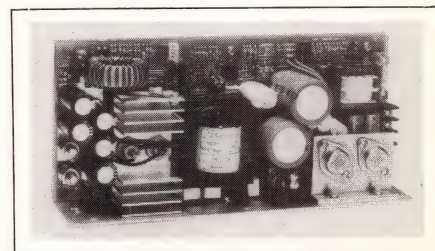
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## POWER CONTROLLER

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**Flourish Electronics Co Ltd, Tenth Floor 5, 35 Shao Hsing N St, Taipei, Taiwan, ROC. Phone (02) 392-1365. TLX 19771.**

Circle No 780



## SWITCHERS

V Series international power supplies comprise 24 models having outputs of 5, 12, 15, and 24V and power ratings of 120, 180, 250, 270, 360, and 500W. The supplies feature UL recognition (file #E478940),



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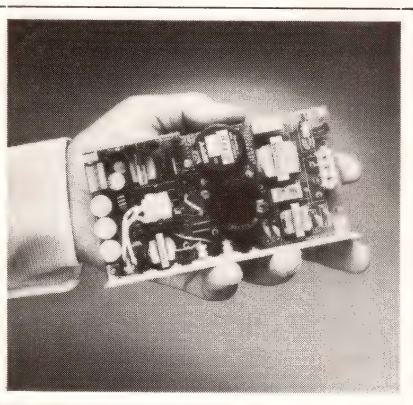
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## Power Sources

CSA certification (file #LR44876), 3750V ac isolation, 8-mm safety spacing, and 80% typ efficiency. Options include logic inhibit, thermal shutdown, and a screen cover. A power-fail monitor is also available. Prices range from \$180 to \$420. Delivery for all units that include the thermal-shutdown option is from stock; for all other models, delivery is four to eight weeks ARO.

**Deltron Inc, Box 1369, North Wales, PA 19454. Phone (215) 699-9261. TWX 510-661-8061.**

Circle No 771



### 3-OUTPUT SUPPLY

The XR-100/3 is a triple-output supply that delivers 70 to 100W continuous and as much as 150W during surges. You can select input ranges of either 95 to 132V ac or 190 to 264V ac, 47 to 440 Hz. The supply provides inrush-current limiting of 20 mA max at 117V ac or 40 mA max at 230V ac.

When using forced-air cooling, the supply's output power cannot exceed 100W continuous. Output #1 supplies 5V at 0 to 12A; #2 supplies 12V at 0 to 8A; and #3 provides -12V at 0 to 0.5A. Outputs 1 and 2 spec 1% line and load regulation, and #3 specs 3% line and load regulation. Pricing starts at \$90 (1000).

**Pacific Power Technology Inc,**  
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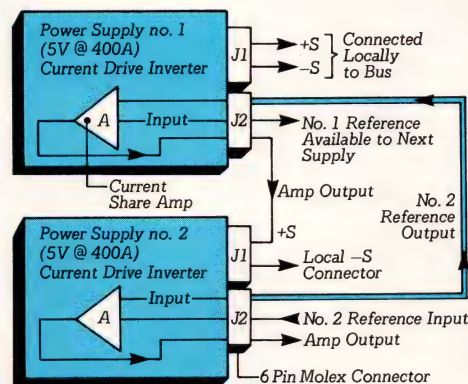




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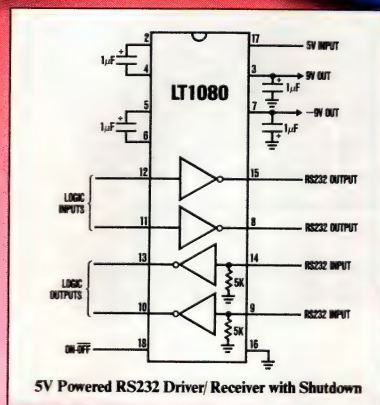
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## Low-power circuit counts contact closures

Roger Davis  
CSIRO, Cunningham Laboratory,  
Brisbane, Australia

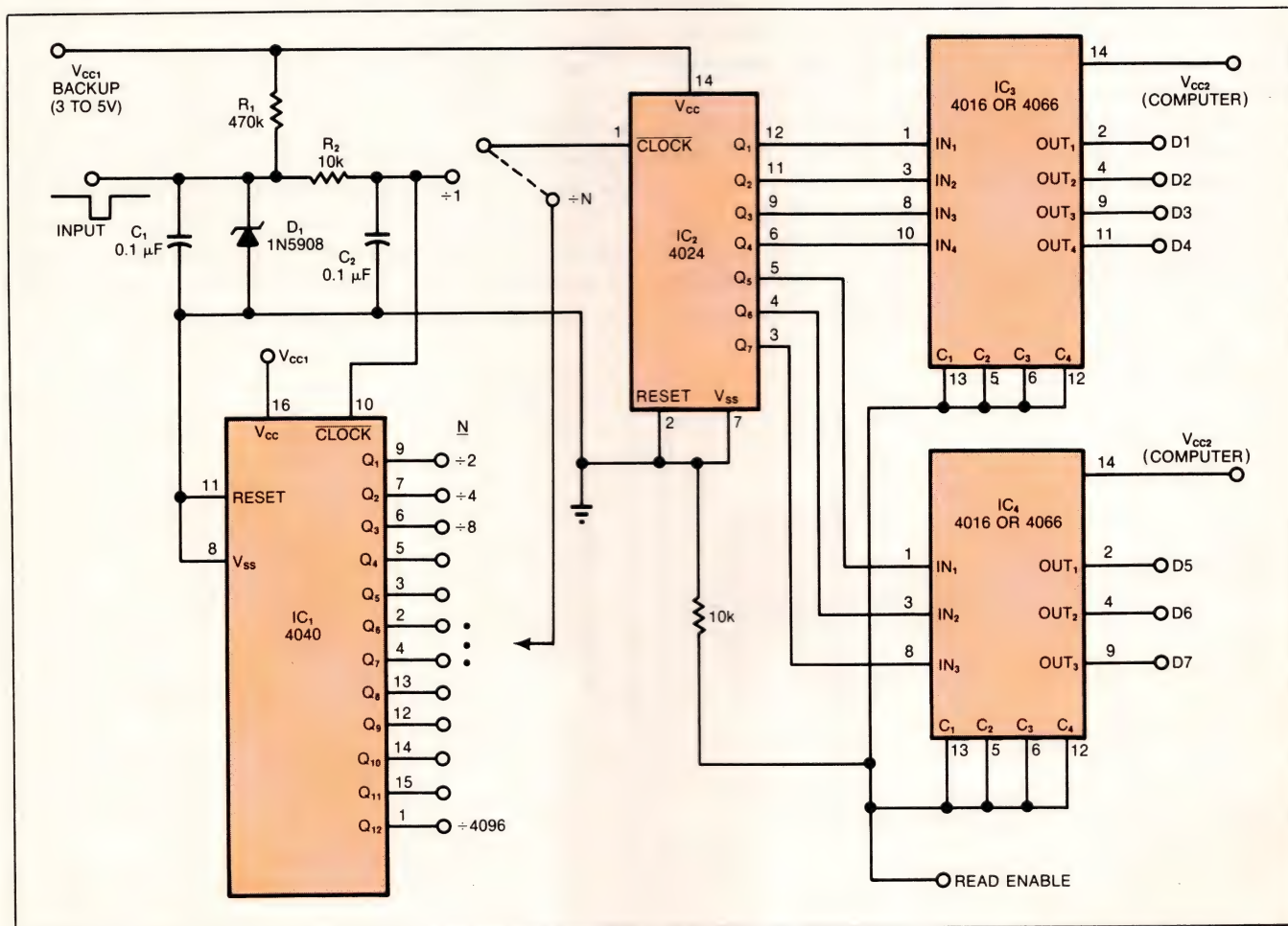
The accumulator circuit in **Fig 1** counts contact-closure inputs for a  $\mu$ P system that must power down for long intervals to conserve battery power. Counter IC<sub>2</sub> counts the closures; the optional counter IC<sub>1</sub> prescales the input as required to avoid overflow during the power-down intervals.

Together, the two CMOS counters draw only a few microamps (at room temperature) from their backup-battery supply  $V_{CC1}$ . When the  $\mu P$  wants to obtain a count, it simply activates the data switches  $IC_3$  and  $IC_4$  by applying  $V_{CC2}$  to pin 14 of each and asserts the common Read Enable. You can use standard-CMOS 4016s if the computer interface sources less than one

low-power Schottky load (360  $\mu$ A). Otherwise, choose HC4016 parts whose lower on-resistance can accommodate higher source currents.

Capacitor C<sub>1</sub> cleans the switch contacts by discharging through them during each closure. A 5V Tranzorb surge-protection device (D<sub>1</sub>) helps protect the circuit against induced voltage caused by lightning, and R<sub>1</sub>, R<sub>2</sub>, and C<sub>2</sub> provide a time constant that lets the counters ignore the lightning pulses but respond to the closure pulses. Both counters should have Schmitt-trigger clock inputs. You can use a 4024 as shown in place of the more expensive 4040 type, but note that not all 4024s have Schmitt-trigger inputs; most 4040s do. **EDN**

**To Vote For This Design, Circle No 747**



**Fig 1—This battery-operated circuit counts contact closures while the host processor is in power-down mode. To obtain a count, the processor turns on  $V_{CC2}$  and asserts the Read Enable.**



## Test whether a noise source is Gaussian

Stuart R Michaels  
ILC Data Device Corp, Bohemia, NY

A spectrum analyzer permits you to measure the bandwidth of a noise source, but you need different equipment to determine whether or not the noise amplitudes have a Gaussian probability distribution. One approach is to use a simple circuit (Fig 1) and a dc voltmeter to measure the circuit's output.

First, it's useful to review the basics. A Gaussian noise voltage (or current) with rms value  $S$  and instantaneous value  $V$  has a probability-density  $p(V)$  distribution defined by the equation

$$p(V) = \frac{e^{-V^2/2S^2}}{S\sqrt{2\pi}}.$$

For given values of  $S$ , the equation produces curves such as those in Fig 2. The probability that the instantaneous value of  $V$  will occur between any particular two levels is the area under the curve between those levels. And the area under each curve from  $-\infty$  to  $+\infty$  is unity because the chance that  $V$  will occur between those limits is 100%.

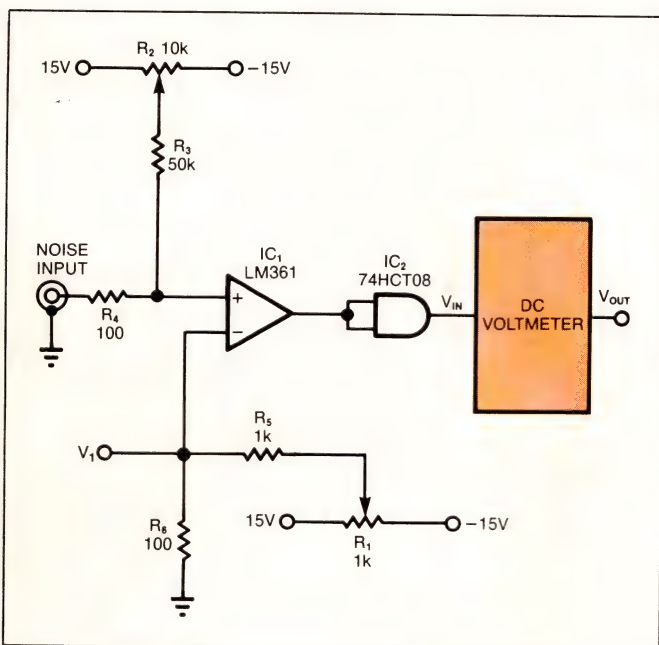
You can calculate the probability that  $V$  will occur between the arbitrary levels  $V_1$  and  $V_2$  by integrating  $p(V)$  between those levels. Or you can calculate the

cumulative probability that  $V$  will occur between a level  $V_1$  and  $+\infty$ . To do this, integrate  $p(V)$  from  $V_1$  to  $+\infty$  for  $V_1$  values between 0V and 10 times the rms value  $S$  (Fig 3). Because the cumulative probability falls off sharply as  $V_1$  increases, you need only consider  $V_1$  values to  $10\times$  the rms level; the probability that noise will exceed  $10S$  is less than 1 ppm. Note also that the noise voltage near 0V has a near-equal chance of being positive or negative. Consequently, the cumulative probability for Gaussian noise near 0V is 0.5, regardless of the rms level.

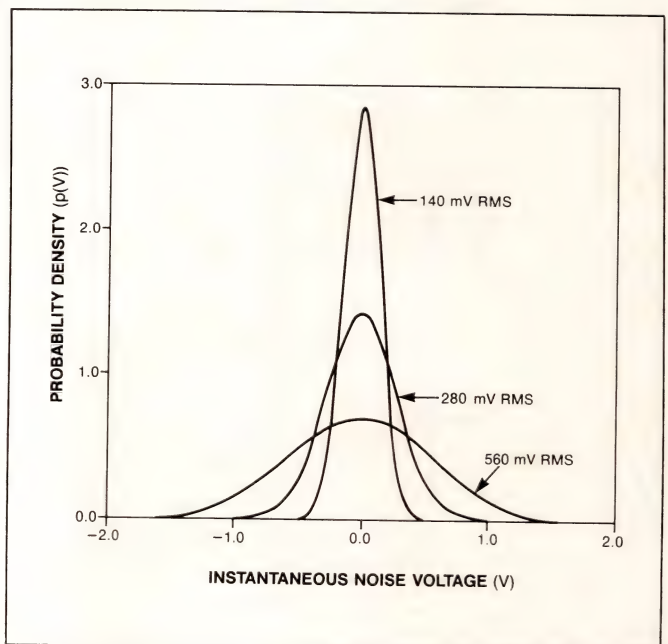
You can use the cumulative-probability circuit of Fig 1 to generate the curves of Fig 3. First, connect the noise source and dc voltmeter as shown and then adjust  $R_1$  for the desired  $V_1$  value at the comparator's inverting input. The AND-gate output  $V_{IN}$  will be high when the input noise is above  $V_1$  and low otherwise, producing a duty cycle corresponding to the cumulative probability that  $V$  will exceed  $V_1$ .

The dc voltmeter's output divided by 5V equals the cumulative probability if the voltmeter input swings between 0 and 5V. The CMOS gate  $IC_2$  provides such an output swing when lightly loaded, provided you adjust the power supply to obtain an accurate 5V output level.

Then, with the noise source connected and  $V_1=0V$ , you can remove the effect of comparator-offset voltage by adjusting  $R_2$  for a voltmeter reading of 2.5V. Under



**Fig 1—This circuit measures the cumulative probability ( $V_0/5V$ ) of the input noise-voltage excursions exceeding the  $V_1$  threshold.**



**Fig 2—The classical Gaussian distributions for noise change shape with the rms level, but the area under all such curves is unity.**



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# DESIGN IDEAS

these conditions,  $V_{IN}$  will spend 50% of the time at 0V and 50% at 5V, yielding a cumulative probability of  $2.5V/5V=0.5$ . A nonzero, positive  $V_1$  will cause  $V_{IN}$  to spend less time at 5V, resulting in a lower value of cumulative probability.

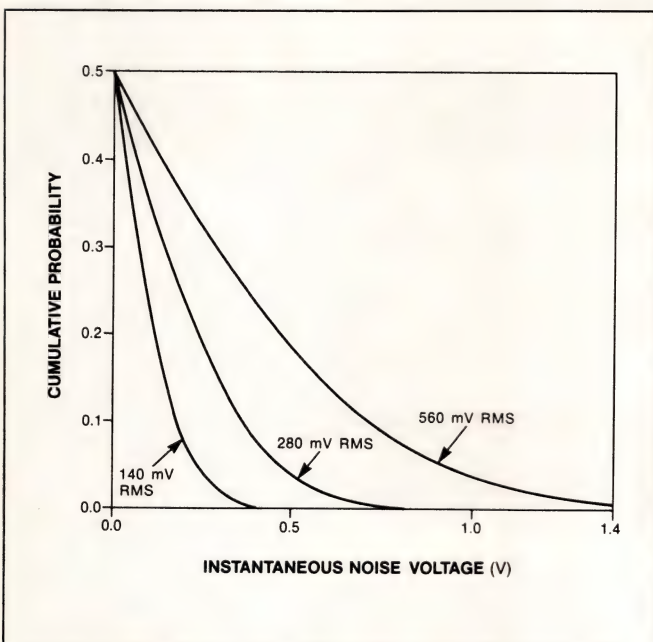
For accurate measurements, the comparator's bandwidth should exceed that of the input noise by a minimum factor of 10. Otherwise, it will cause error in the comparison of measured and theoretical cumulative probabilities—that is, by reducing the measured rms voltage. To avoid this problem, you should take into account certain factors. For  $V_1=S$ , the theoretical cumulative probability for Gaussian noise is 0.1589. If you adjust  $V_1$  until  $V_0=794.3$  mV (which corresponds to a cumulative probability of 0.1589),  $V_1$  will equal the rms noise voltage  $S$ . Further, the noise source is Gaussian if you get this same value of  $V_0$  for various multiples and

submultiples of  $V_1$ .

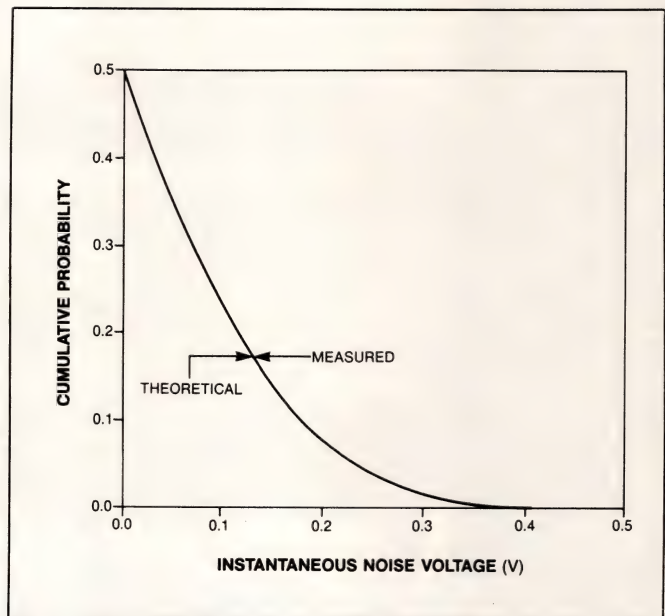
**Fig 4** illustrates the result obtained when using **Fig 1**'s circuit to test a Gaussian source that's part of a commercial noise tester. The congruence of the curves for measured and theoretical data indicates the source is "very" Gaussian. (*Ed Note: But how do you quantify degrees of "Gaussianity"? The author will welcome a call at (516) 567-5600 from anyone with suggestions about this matter. He has used the Fig 1 circuit on many BUS-68015 testers; all test results look about the same unless a circuit fault is present. In such a case, the measured data deviates from the theoretical only in the central portion of the curve.*)

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**Fig 3**—**Fig 1**'s circuit yields these cumulative-probability curves, which correspond to the Gaussian distributions in **Fig 2**.



**Fig 4**—This curve shows the result of using the **Fig 1** test circuit and illustrates near-ideal Gaussian characteristics for the noise source in a commercial noise tester.

## Variable-gain amplifier uses matched FETs

Burton S Abrams and Daniel R Frey  
Zeger-Abrams Inc, Glenside, PA

A FET can vary the gain of an amplifier by serving as a variable-resistance element, but because the FET's pinch-off voltage varies with temperature and from unit to unit, the control voltage for a particular gain is

not fixed. In **Fig 1**, though, a given control voltage  $V_{CONTROL}$  produces the same channel resistance in the gain-control FET  $Q_{1B}$  for different FET pairs regardless of any variation in their parameters.

The lower circuit ( $IC_2$ ) is a generalized inverting amplifier whose dc gain varies inversely with the channel resistance of  $Q_{1B}$ . The top half of the circuit



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(IC<sub>1</sub>) generates a gate-to-source voltage for master FET Q<sub>1A</sub> that applies to the slave FET Q<sub>1B</sub> as well.

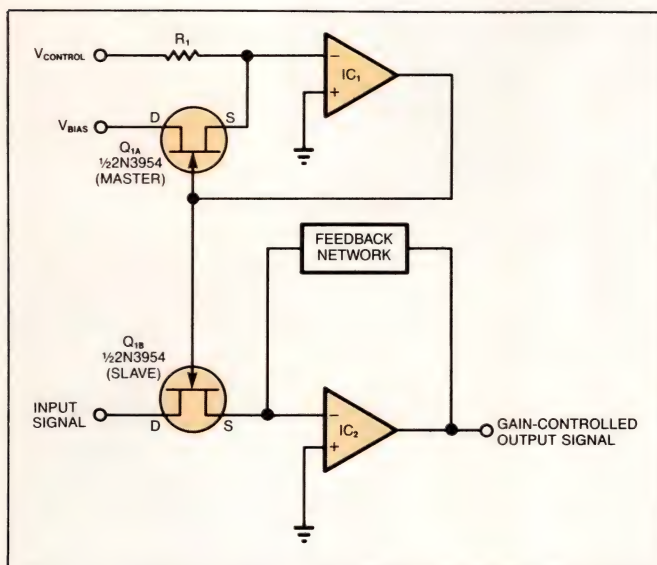
You apply the negative voltage V<sub>CONTROL</sub> to set a constant current through R<sub>1</sub> that flows into the source of Q<sub>1A</sub>. Op amp IC<sub>1</sub> adjusts Q<sub>1A</sub>'s gate voltage to accommodate this current. Because the small positive voltage V<sub>BIAS</sub> is fixed, Q<sub>1A</sub>'s channel resistance must always assume the same value in response to a given value of V<sub>CONTROL</sub>. And because Q<sub>1B</sub> is a closely matched FET

with the same gate-source voltage, it will assume the same channel resistance as Q<sub>1B</sub>.

V<sub>BIAS</sub> should be much smaller than the FET's pinch-off voltage so that the FET will not operate in its saturation region. And R<sub>1</sub> must be large enough to avoid demanding a lower resistance than Q<sub>1A</sub> can provide.

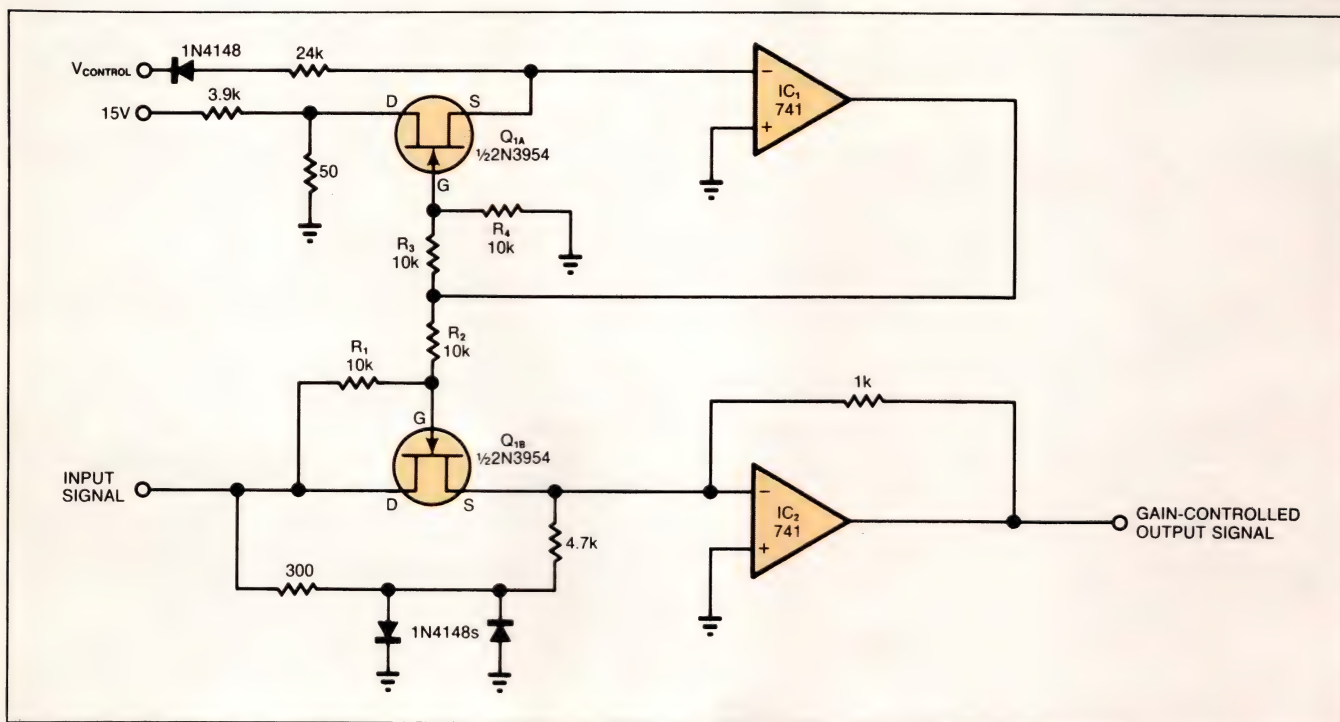
The circuit in Fig 2 includes additional refinements that compensate for other undesirable characteristics of Q<sub>1B</sub>. Q<sub>1B</sub>'s resistance is not only a function of gate-to-source voltage but of drain-to-source voltage as well, which varies with the input signal. The resulting output nonlinearity becomes more pronounced with an increasing signal level. In a familiar approach, the 10-kΩ resistors R<sub>1</sub> and R<sub>2</sub> mitigate this effect by applying about half the signal voltage to Q<sub>1B</sub>'s gate bias voltage.

R<sub>1</sub> and R<sub>2</sub> also divide in half the gate voltage applied to Q<sub>1B</sub> by the output of IC<sub>1</sub>, so R<sub>3</sub> and R<sub>4</sub> are added to reduce Q<sub>1A</sub>'s gate voltage by the same amount. Still, signal distortion is noticeable when Q<sub>1B</sub>'s resistance is high. A diode-resistor network shunts Q<sub>1B</sub> to compensate for this distortion at the expense of gain-control range. The circuit provides a 20-dB gain-control range for ±1V-max input signals, and it exhibits a maximum 7% output distortion—sufficient for use as an integrator within a phase-locked loop, for example. **EDN**



**Fig 1**—You use the negative voltage V<sub>CONTROL</sub> to set this amplifier's gain. The matched dual-FET circuit ensures that a given gain is unaffected by the use of different FET pairs or by the effect of temperature on FET parameters.

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**Fig 2**—This circuit is similar to that of Fig 1, but it includes refinements that compensate for signal distortion caused by high FET resistance and for distortion caused by varying drain-to-source voltage.



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## TV sync generator acts as clock timebase

Andrew Dart

Trans-Texas Telegraph Co, Duncanville, TX and

Richard Kihn

KSDM TV, Beaumont, TX

A digital-clock chip that requires a 60-Hz reference may drift three to four seconds every 48 hours when connected to the power line. The clock will maintain  $\pm 0.5$ -sec accuracy, though, if you derive its 60-Hz reference from a TV signal's vertical sync pulses.

A TV station's sync generator contains a temperature-stabilized crystal oscillator that governs the station's horizontal- and vertical-sync pulse rates and color-subcarrier frequency. This oscillator in turn tracks the network signal, which is derived from atomic standards. The result is a stable subcarrier frequency:

$$f_{\text{SUBCARRIER}} = 5 \text{ MHz} \times \frac{63}{88} = 3.5795454545 \dots \text{ MHz.}$$

The station's vertical-sync signal frequency is

$$f_{\text{VSYNC}} = f_{\text{SUBCARRIER}} \left( \frac{2}{455} \right) \left( \frac{2}{525} \right) = 59.9400599400 \dots \text{ Hz.}$$

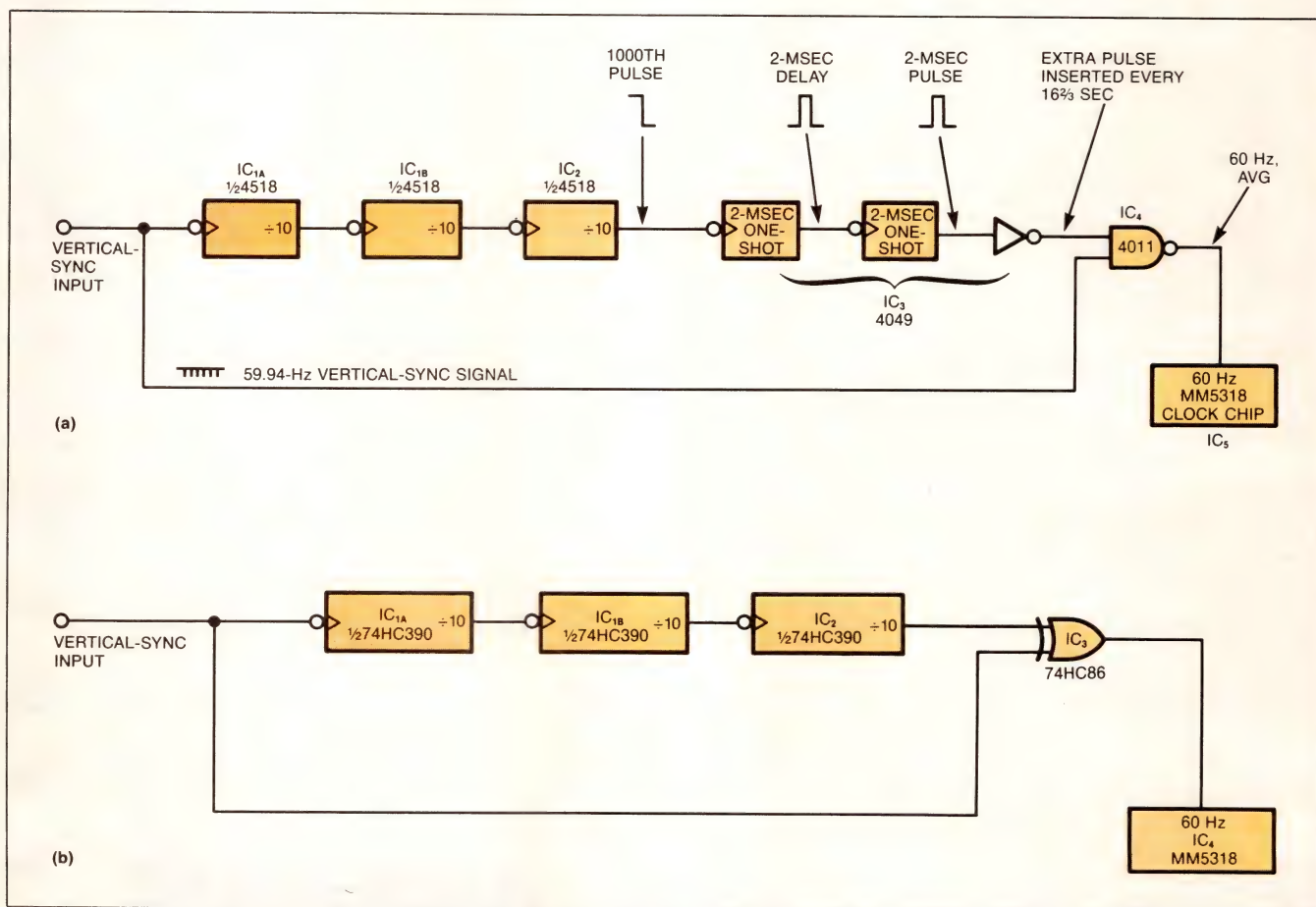
So, **Fig 1a**'s circuit multiplies  $f_{\text{VSYNC}}$  by 1.001 to obtain an exact 60-Hz reference frequency  $f_{\text{REF}}$ :

$$f_{\text{REF}} = \frac{5,000,000(63)(2)(2)(1001)}{1(88)(455)(525)(1000)} = 60 \text{ Hz.}$$

The circuit has been in continuous use for 10 years without causing any problems. Using currently available components, however, you can get the same performance from a simpler circuit (**Fig 1b**).

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**Fig 1—By inserting one extra pulse every 1000 pulses, the circuit in **a** converts the vertical-sync signal of 59.94[... ] Hz to a clock-reference frequency that averages 60 Hz. The circuit in **b** performs the same task but uses fewer parts.**



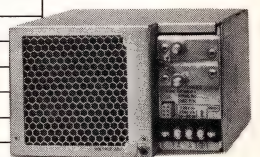
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CIRCLE NO 179



## Bias supply is temperature compensated

Robert J Inkol  
Defense Research Establishment, Ottawa,  
Ontario, Canada

Avalanche photodetector diodes require a high-voltage bias supply, and their gain characteristic (input light vs output current) varies with temperature. If your bias supply has an adjustable temperature coefficient, however, you can compensate for this temperature-dependent gain.

The Fig 1 circuit is a regulated power supply;  $R_1$  sets the negative-voltage output (to  $-425\text{V}$ ), and  $R_2$  sets the output's required temperature coefficient. For the ca-

pacitor values shown, the supply can handle  $\pm 10\%$  line variations. And because the unregulated input section is floating, only the  $Q_1$  pass transistor requires a high breakdown voltage.

$IC_3$  is a precision op amp operating with shunt feedback, which simplifies the stage's adjustment and its analysis as well:

$$I_1 = 6.9\text{V}/R_1$$

$$I_2 = (T + E)\mu\text{A}/^\circ\text{K}, \text{ and}$$

$$I_3 = -V_{\text{OUT}}/R_2$$

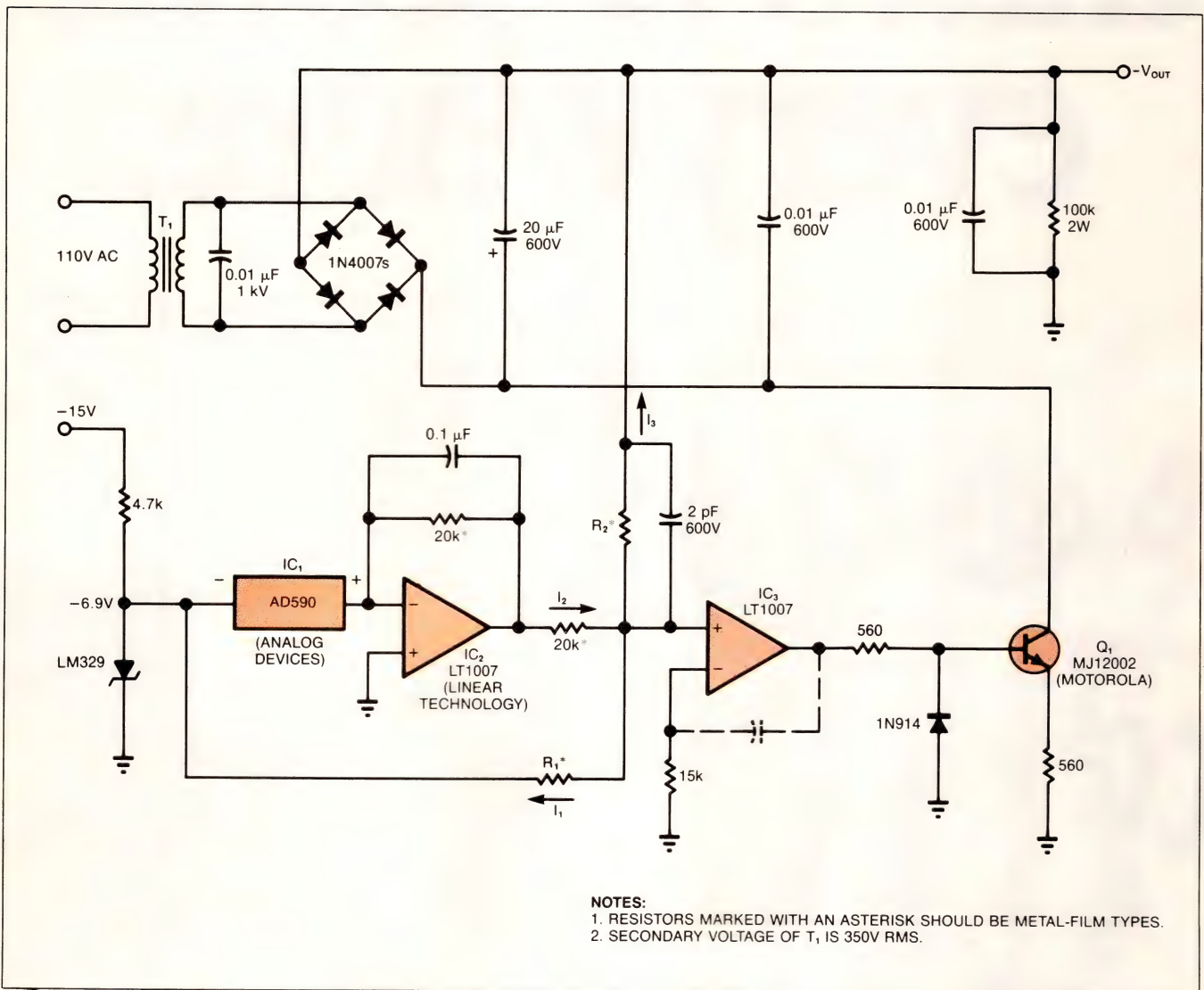
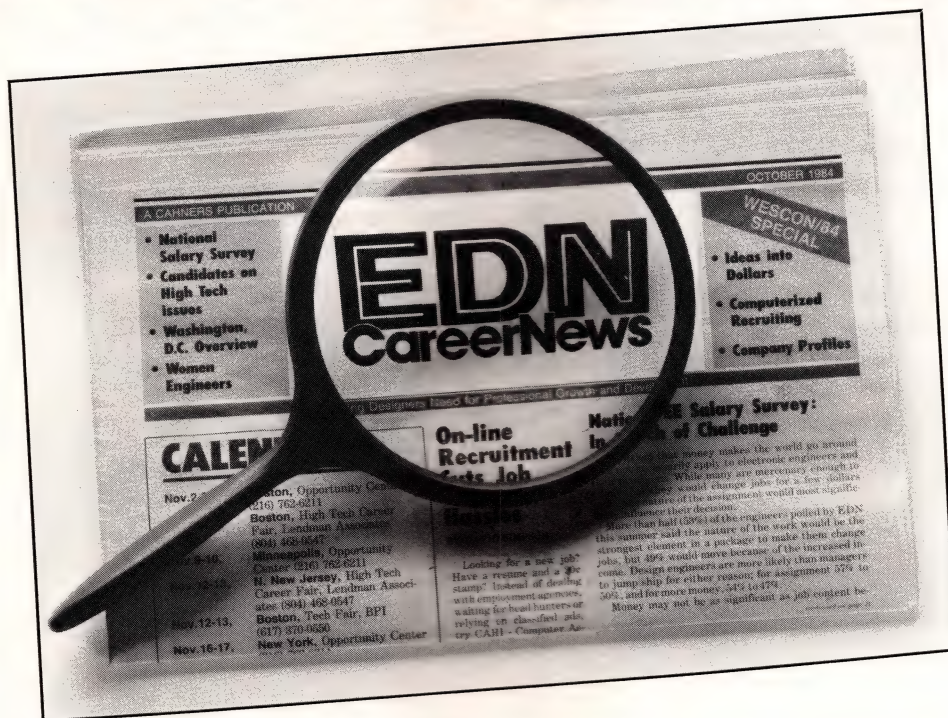


Fig 1—This high-voltage bias supply provides independent adjustment of output voltage ( $R_1$ ) and output temperature coefficient ( $R_2$ ).



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where resistance is in ohms,  $T$  is the absolute temperature in degrees Kelvin, and  $E$  is the temperature-calibration error of temperature sensor  $IC_1$ . (In this circuit,  $IC_1$  acts as a variable resistor that conducts an accurate  $1 \mu A$  per degree Kelvin.) Summing the three currents to zero yields

$$-V_{OUT} = (-R_2/R_1)6.9V + R_2(T+E) \mu A/^{\circ}K.$$

The above equation shows that you can adjust the output voltage and the temperature coefficient without iteration. First, select  $R_2$  for the desired temperature coefficient:

$$\frac{dV_{OUT}}{dT(^{\circ}K)} = -R_2 \left( \frac{1 \mu A}{^{\circ}K} \right).$$

A 2.4-M $\Omega$  value, for example, sets the bias-voltage temperature coefficient to 2.4 mV/ $^{\circ}C$ , as required in this case by the C30985 photodiode from RCA.

Next, select  $R_1$  for the desired output voltage:

$$V_{OUT} = - \left[ -\frac{R_2}{R_1}(6.9V) + R_2(T+E) \mu A/^{\circ}K \right].$$

(To avoid measuring  $E$ , you can replace  $R_1$  with a variable resistor and empirically adjust for  $V_{OUT}$ .) The circuit is stable as shown, using 2.4 M $\Omega$  for  $R_2$ . For lower  $R_2$  values, you may need to restore stability by adding a capacitor of approximately 1000 pF (represented by the dotted lines).

You should mount the temperature sensor,  $IC_1$ , on the photodiode package, with good thermal contact between them. Note that the power supply turns off automatically if you accidentally disconnect the temperature sensor. Maximum output current is about 20 mA, if you use a 560 $\Omega$  emitter resistor for  $Q_1$  and a  $\pm 15V$  supply for  $IC_3$ . For  $Q_1$ , you must provide a heat sink that's adequate for the anticipated output current and voltage.

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16K SRAM	HY61C69	4Kx4	25,35,45,55,70	22-pin DIP (300)
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64K SRAM	HY62C64A	8Kx8	35,45,55,70	28-pin DIP (600)
64K SRAM	HY62C87	64Kx1	35,45,55	22-pin DIP (300)
64K SRAM	HY62C88	16Kx4	35,45,55	22-pin DIP (300)
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## LITERATURE: COMPONENTS

### Update on switching relays

This catalog contains information on different types of coaxial relays, which feature time-delay auxiliary contacts and ac and dc operation. The booklet also highlights unshielded RF switching relays. It is 3-hole punched for loose-leaf filing.

**Magnecraft Electric Co.**, 1910 Techny Rd, Northbrook, IL 60062.

Circle No 647

### Guide helps in selecting active filters

This design and selection guide covers lowpass, highpass, and band-pass/reject filters and high-purity sine-wave oscillators available in fixed-frequency, resistive-tunable, and digitally programmable models. It also details filters for telecommunications and antialiasing applications. The 245-pg book contains a glossary of technical terms, complete specifications for 56 product

families, and a 25-pg tutorial section on active-filter theory, design, and applications.

**Frequency Devices Inc.**, 25 Locust St, Haverhill, MA 01830.

Circle No 649

### Catalog delineates surface-mount components

A 48-pg catalog (ASP-600A) covers the manufacturer's line of components designed for surface-mount applications. The catalog describes discrete semiconductors, sensors, interface and linear ICs, tantalum and multilayer-ceramic capacitors, resistor networks, computer delay lines, and inductors. Extensive tables and graphs portray device ratings and electrical characteristics. For each device type, the catalog gives component dimensions, tape and reel specifications, device orientations, and quantities of parts per reel. Applications data includes



mounting, soldering, and board-cleaning recommendations, as well as standard pad layouts.

**Sprague Electric Co.**, Technical Literature Service, Box 9102, Mansfield, MA 02048.

Circle No 657

### Brochure reviews surface-mounting methods

*Surface Mounting Today* (#81409), a 16-pg brochure, begins with an overview of the limitations and capabilities of surface-mounting methods. It discusses housing materials, lead shapes, and designing for solder-joint reliability. In addition, it covers the characteristics that affect product performance and effective testing strategies as they relate to the company's surface-mount products. Descriptions of typical surface-mounting interconnection parts include DIP and chip-carrier sockets, subminiature D connectors, pc-board connectors, and 0.025-in. square-pin headers. Four-color photos and drawings supplement the descriptions.

**AMP Inc.**, Box 3608, Harrisburg, PA 17105.

Circle No 646

### Brochure touches on motion controllers

This short-form brochure briefly describes the company's motion-control products. These include the dc Servodisc armature motors, ranging from less than 1/25 to 10 hp, the dc Servodisc gear motors, PWM servo amplifiers, and the Synchrostep step motors and chopper drives. In

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## LITERATURE

addition, it highlights a series of optical encoders.

**PMI Motion Technologies**, 49 Mall Dr, Commack, NY 11725.

Circle No 648

### Data on a disk aids in product selection

The *MOSpower Computer Data Book* resides on a 5¼-in. disk and runs on an IBM PC or compatible. The program searches for and displays device options either from specific part-number input or from device parameters defined by the user. The data book also includes an automatic power-MOSFET cross-reference for selecting alternate components according to other manufacturers' part numbers.

**Siliconix Inc**, 2201 Laurelwood Rd, Santa Clara, CA 95054.

Circle No 650

### Pamphlet addresses terrestrial interference

This pamphlet describes the manufacturer's filters, which suppress terrestrial interference in more than 400 satellite receivers. The brochure concentrates on three filter lines that are used to solve most T1 problems, and it contains a list of receivers and filters compatible with the lines. In addition, it contains a TVRO-interference analysis form, which you can fill out and send in for a specific filter recommendation if a particular receiver isn't listed. Finally, the pamphlet includes information on how to identify interference.

**Microwave Filter Co Inc**, 6743 Kinne St, East Syracuse, NY 13057.

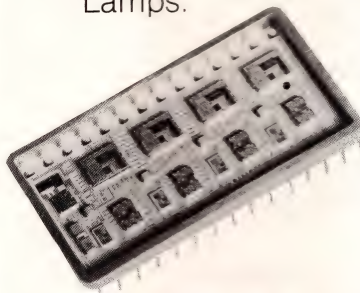
Circle No 651

### Publication describes power tubes and cavities

*Power Tubes*, a 52-pg product guide, gives technical data on the manufacturer's line of tubes and associated components. The guide features separate sections for broadcast, communications, and special-pur-

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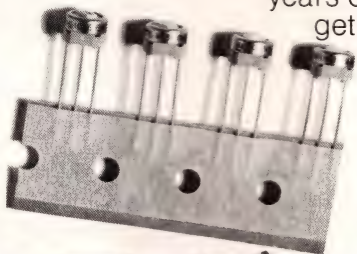
CIRCLE NO 181

## **BI** means standard trimmers made special for you.

We offer a broad line of standard rectangular and square multiturn, single turn, and surface mount trimmers. But we feature something more—a special knack for solving your applications problems through modified components and packaging, including tape and reel, tube and ammo pack. When you design in Beckman Industrial Corp. products, you not only get 45

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CIRCLE NO 182

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D1



## LITERATURE

pose types as well as a section on tube characteristics. The broadcast section includes a quick-reference guide for selecting tubes and cavities for various AM, FM, and TV applications. Other selection guides cover other types of tubes.

RCA, New Products Div, Tube Operations Marketing, New Holland Ave, Lancaster, PA 17604.

Circle No 652

### Catalog summarizes 1986 offerings

This 12-pg 1986 product summary covers the company's data-conversion and fiber-optic data-link offerings, including such products as V/F and F/V converters, A/D and D/A converters, S/H amplifiers, and FET op amps. The short-form format helps you choose the appropriate product: It contains selection guides and tables of key specifications. In addition to products, the catalog describes the vendor's custom hybrid-design and manufacturing capabilities in thick- and thin-film, military- and power-hybrid technologies.

Dymec Inc, 8 Lowell Ave, Winchester, MA 01890.

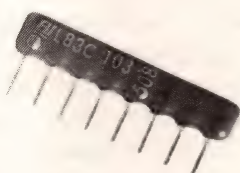
Circle No 653

### Catalog describes communications amplifiers

This 12-pg catalog describes the manufacturer's line of RF, IF, and mixer amplifiers. In addition to a mature series of standard fixed- and variable-gain RF and mixer amplifiers, the catalog includes a range of new products; for example, a series of fixed-gain, high-power RF amplifiers and voltage-controlled, variable-gain RF amplifiers. Also included in the new series are a line of IF preamplifiers, buffer amplifiers, and limiting amplifiers, as well as video amplifiers having frequency response from dc to 40 MHz. The RF amplifiers described in the catalog cover the frequency range from 100 kHz to 400 MHz. Typical curves

## ***BI*** means standard networks made special for you.

We offer a broad line of RESNET® dual in-line thick and thin film, and single in-line thick film resistor networks. But we feature something more—a custom capability for special resistance values, combinations and packages to meet your requirements. When you design in Beckman Industrial Corp. products, you not only get 45 years of quality leadership, you get custom attention to your needs as well. And you don't have to ask for it; it's standard.



For applications assistance or the ***BI*** Resistive Products Short Form Catalog, call (714) 447-2700.

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CIRCLE NO 183

## ***BI*** means standard pots/dials made special for you.

We offer a broad line of standard HELIPOT® single as well as 10-turn pots, and analog as well as digital turns-counting dials. But we feature something more—a special design expertise that gets to the heart of your unique requirements, including servo sub-systems, precision electro-mechanical assemblies and other highly specialized applications. When you design in Beckman Industrial Corp. products, you not only get 45 years of quality leadership, you get custom attention to your needs as well. And you don't have to ask for it; it's standard.

For applications assistance or the ***BI*** Resistive Products Short Form Catalog, call (714) 447-2700.



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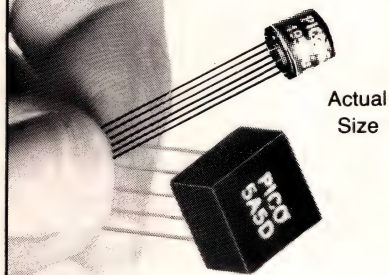
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CIRCLE NO 184

NETWORKS POTS/DIALS



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CIRCLE NO 185

## LITERATURE

show the amplifiers' frequency response, 1-dB compression characteristics, VSWR, and return loss.

**TIW Systems Inc.**, 1284 Geneva Dr, Sunnyvale, CA 94089.

Circle No 658

accelerometer's input reference axis.

**Systron Donner**, Inertial Div, 2700 Systron Dr, Concord, CA 94518.

Circle No 659

## All about thermometers

*The ABC's of Thermometers*, a 16-pg brochure, explains the theory behind thermometers, focusing on how thermocouples work, how you can use them, and how to reduce temperature-measurement error. It also contains a section on refrigerator work and the types of temperature measurements that can pinpoint potential trouble spots. A glossary and a thermocouple selection guide aids in choosing the right tool for a particular application. In addition, the brochure lists the company's temperature-measurement products, including digital thermometers, a thermocouple adapter for digital multimeters (DMMs), and a semiconductor probe for use with DMMs.

**John Fluke Mfg Co**, Box C9090, Everett, WA 98206.

Circle No 655

## Technical paper lists accelerometer attributes

*Chalk Talk*, a 4-pg technical bulletin, describes the principal performance characteristics of linear servo accelerometers. The paper is written to aid the design engineer in evaluating accelerometer performance as it relates to overall system accuracy. Examples of the bulletin's subjects of analysis are bias, scale factor, linearity, hysteresis, frequency response, and phase shift. A working example illustrates the optimum way to combine certain tolerances and performance errors to obtain the best possible performance in a given application. The bulletin presents a model equation that relates the output of an accelerometer to the components of acceleration applied parallel to and normal to the

## Booklet presents fundamentals of displays

A 12-pg booklet, *Selecting the Right Display*, covers such display technologies as raised cathode, screened image, and vacuum fluorescent. Separate sections review applications, character formats, brightness measurements, character height vs viewing distance, color, active and passive technologies, data interface and format, viewing angle, configurations, customization, and components vs subsystems.

**Babcock Display Products Inc.**, 1051 S East St, Anaheim, CA 92805.

Circle No 656

## Transducer line covered

This full-color catalog provides prices and specs for the manufacturer's line of pressure transducers, load cells, accelerometers, displacement transducers, and associated instrumentation. For each product line, the catalog describes a variety of models, including those that spec high precision, miniature size, low cost, high- or low-temperature capabilities, submersibility, and high capacity. All devices' specs include working range, accuracy, dimensions, and prices. The transducers cover pressure ranges from vacuum to 200,000 psi, load ranges from 50g to 3,000,000 lbs, linear displacement from 0.01 to 18 in., and useful accelerometer frequencies from 0 to 2000 Hz. The transducers are suitable for industrial and lab applications.

**Sensotec Inc.**, 1200 Chesapeake Ave, Columbus, OH 43212.

Circle No 660



# Our newest military 1 MHz DC-DC converter: built for critical environments



## The Power Technology Group of Inland Motor continues to advance the technology in high density Military power conversion.

We have improved our benchmark 1 MHz, zero current switching forward converters for even more demanding applications. We call our new line the RC/RB series of converters and power boosters. This new line now offers as standard features:

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EDN December 11, 1986

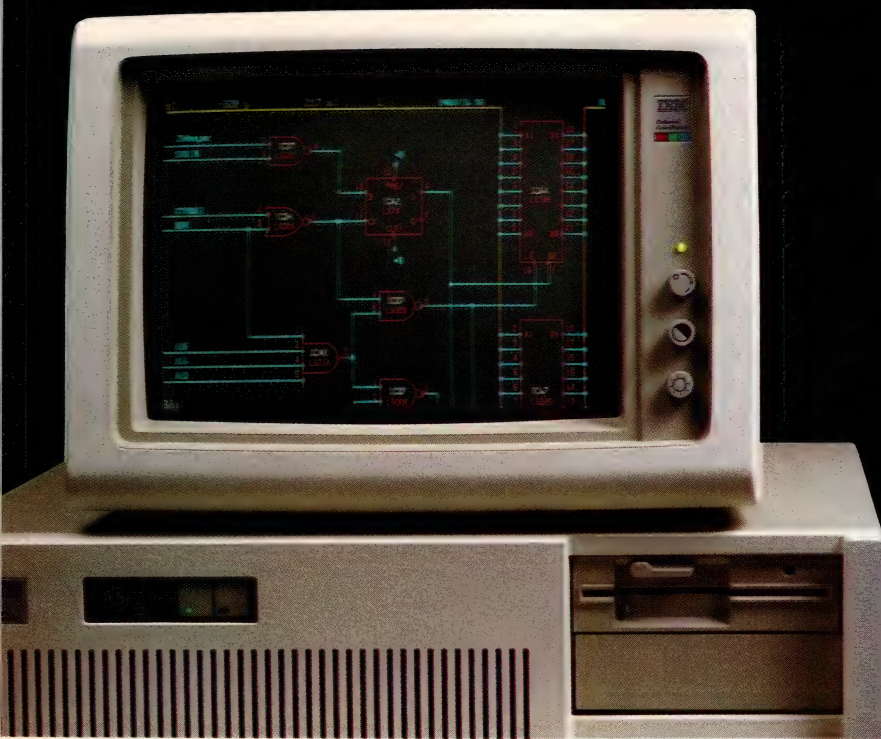


## Power Technology Group Inland Motor

A Division of Kollmorgen Corp.

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### DRAFTSMAN-EE VERSION 2.0

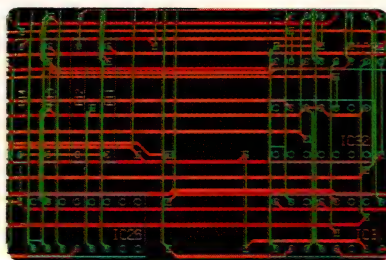
DRAFTSMAN-EE 2.0 offers the power and capabilities you would expect in \$4000 schematic capture software, plus some: features like unlimited zoom, nested symbols, orthogonal and diagonal rubber-banding, easy manipulation of any screen region—not just rectangular regions, open architecture, and virtually no limits on drawing size or complexity. DRAFTSMAN-EE 2.0 comes complete with a symbol library and parts list and bill of materials report generators.

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DC/AUTOROUTER II is a high-end, PC-based autorouter that is winning benchmark after benchmark. With its low-cost, true diagonal autorouting, high completion rates, and professional results, DC/AUTOROUTER II is the package you'll want at your workstation.

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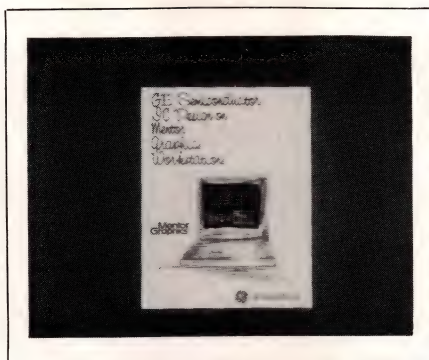


## Manual helps in surface-mount design

This design manual takes you step by step through the process of surface-mount-technology (SMT) design. A condensed guide, it covers such topics as product selection and analysis, trends in SMT packaging and design, types of SMT assemblies, substrates, and thermal effects. One chapter addresses SMT package specifications and discusses standards. The book also discusses how to generate designs both manually and with a CAD system. Finally, it includes a set of design rules and a set of instructions for designing a practice SMT board. \$350.

**Surface Mount Technology Plus**, 1786 Technology Dr, San Jose, CA 95110.

**INQUIRE DIRECT**



and timing simulation on Mentor Graphics' Idea Series CAE workstations. The 4-pg booklet highlights the kit's symbol libraries and logic models for the design of 2- $\mu$ m gate arrays and standard cells; it also details the Idea network editor, remote simulator software, and document-preparation system.

**GE Semiconductor**, 318 First St, Liverpool, NY 13088.

**Circle No 555**

## Book categorizes ASICs

*Semicustom Databook For CMOS Gate Arrays and Standard Cells*, a 220-pg publication, catalogs the macrocell libraries available for designing IGC20000 Series gate arrays and ISC20000 Series standard cells. Divided into seven sections, the book provides an overview of the manufacturer's ASICs (application-specific integrated circuits), including such data as characteristics, descriptions of workstation support and the company's CAD system, and a process summary for converting gate arrays to standard cells. In addition, it describes all internal macrocells, I/O macrocells, Flexicells, and ISC20000 megacells in the series' libraries (including RAM, ROM, and GE2900 Series microprocessor functions).

**GE Semiconductor**, 318 First St, Liverpool, NY 13088.

**Circle No 556**

## Brochure for designing ICs

This brochure explains how to use the company's 2- $\mu$ m design kit to perform schematic capture, logic simulation, test-vector generation,

## Disk explains pc-board CAD

This combination demonstration disk/synchronized audio cassette allows you to preview the vendor's Quik Circuit pc-board layout system before deciding whether you should buy it. The program runs for 35 minutes, but you can stop it at any time to put the software through its paces on your own. The disk—as well as the actual pc-board layout software—runs on a Macintosh (with at least 128k bytes), XL, Lisa (with Macworks), or Macintosh Plus. \$15; pc-board layout software, \$695.

**Bishop Graphics CAD System Corp**, 5388 Sterling Center Dr, Westlake Village, CA 91359.

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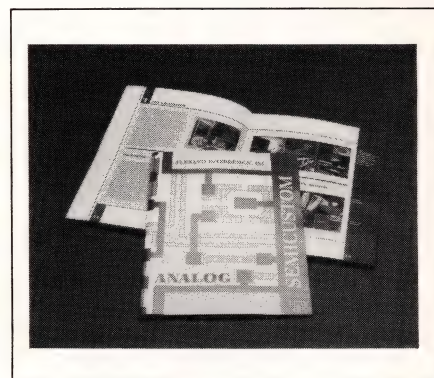
## Public-domain programs for RF filters and networks

This 4-pg catalog lists public-domain programs (written mostly in Basic) for the design of filters, networks, microstrip lines, parabolic antennas, and other RF devices. The booklet includes a form that you can use to order the programs, which

the organization supplies on four 5¼-in. floppy disks in 360k-byte, PC-DOS/MS-DOS format. Many of the programs described in the catalog are accompanied by the text of the published articles in which the programs appeared.

**EE Public Domain Library**, 36 Irene Lane E, Plainview, NY 11803.

**INQUIRE DIRECT**



## Guide to analog design

This 17-page brochure gives detailed information on analog semicustom circuit design with the vendor's Monochip arrays. It includes step-by-step descriptions of the design and integration procedures, available components and their key parameters, and CAD tools that you can use for circuit analysis. The brochure also describes the available types of packaging, the vendor's production and test facilities, and quality-assurance procedures. A question-and-answer section provides information on cost, delivery times, second sources, secrecy, and warranties.

**Ferranti Interdesign**, 1500 Green Hills Rd, Scotts Valley, CA 95066.

**Circle No 558**

## Tutorial helps you use AutoCAD effectively

The AutoCAD Productivity Book, which is written by experienced users, shows you how to use the full power of the program. Section 1 includes seven chapters that teach you how to create your own menus,



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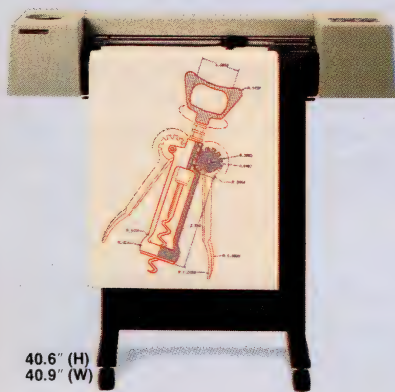
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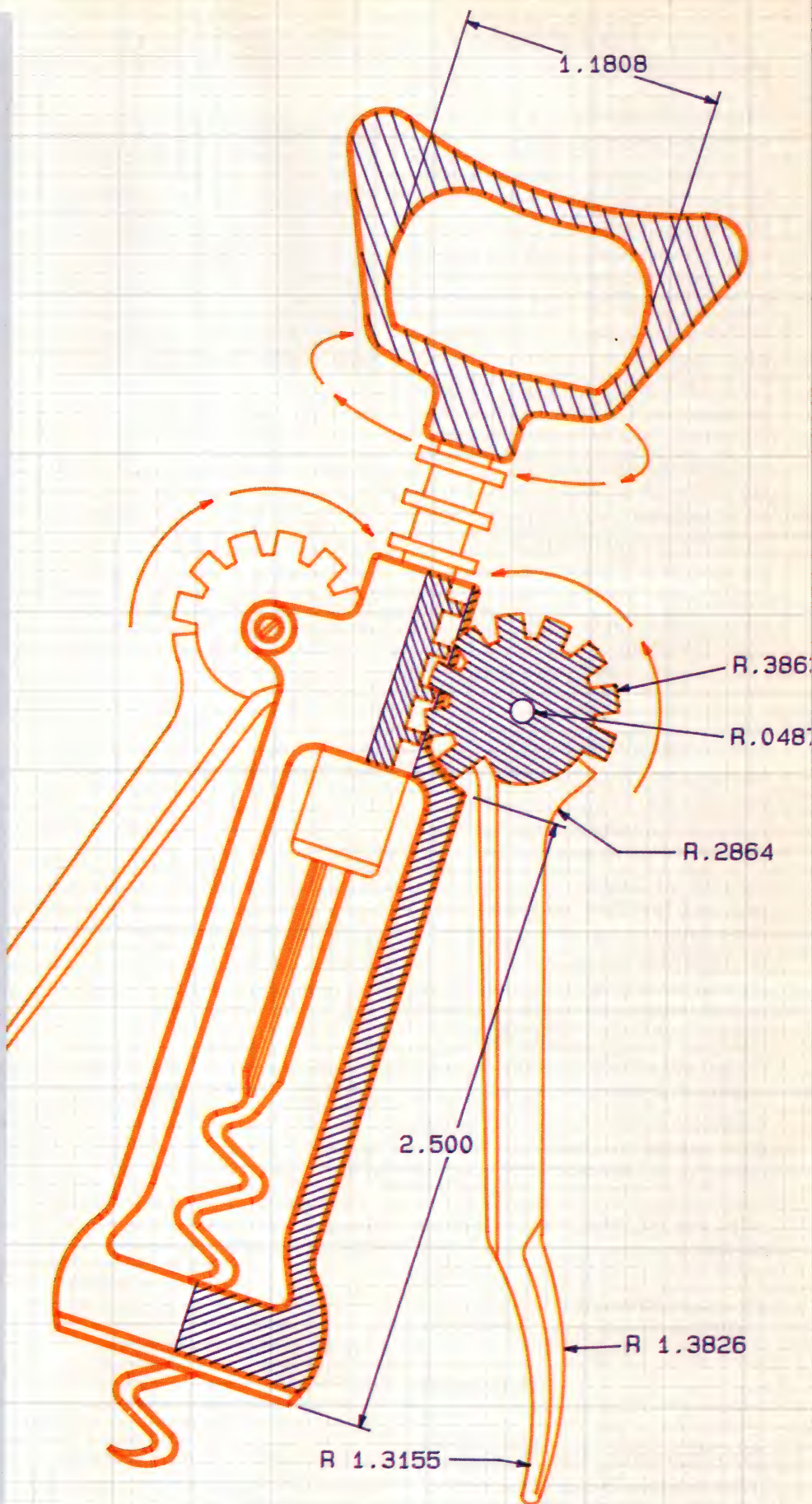
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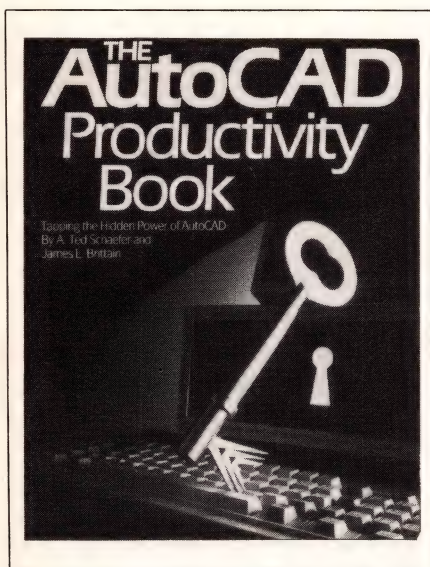


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fine-tune your system, create and edit macros, and automate your drawings. A special chapter in this tutorial section instructs you in using DOS features to manage your AutoCAD sessions and files effectively. The second section is a library of 70 AutoCAD macros and

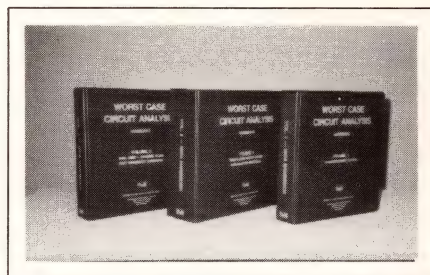
Lisp routines that you can enter into your computer to automate zoom, pan, and layer commands; hatching and symbol insertion; and commonly used shapes. \$39.95.

**Ventana Press**, Box 11004, Piedmont, CA 94611.

Circle No 559

## Handbook of worst-case circuit analysis

This 3-volume handbook introduces the topic of worst-case circuit analysis (WCA) and shows how to meet the requirements of MIL-STD-785B. Volume 1 explains the fundamental concepts of WCA and takes you step by step through the construction of a well-organized, cost-effective WCA report. Volume 2 describes the operating principles, sources of error, and critical parameters for major classes of circuits. Volume 3 shows you how to develop worst-case envelopes for electronic



components in a variety of environments. The volume includes worst-case data sheets for popular electronic parts, covering temperature ranges of  $-20$  to  $+80^{\circ}\text{C}$ , 10-year life, and nonradiation environments. \$395.

**Design and Evaluation Inc**, 1000 White Horse Rd, Voorhees, NJ 08043.

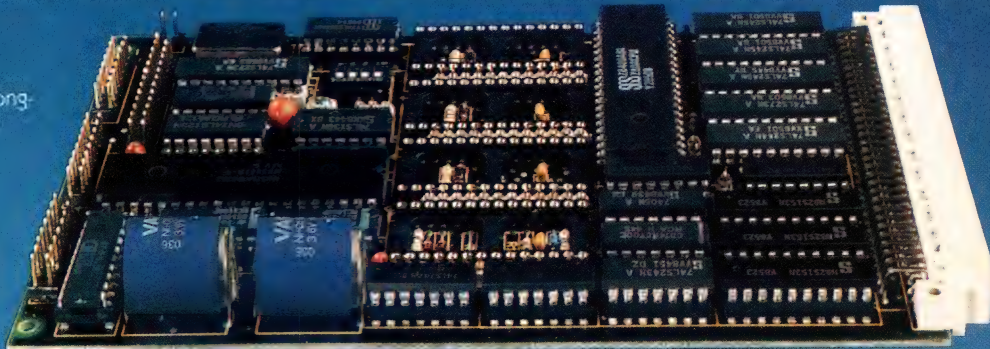
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The advantages of these miniature energy sources: small and compact, low profile, suitable for trickle charge, high resistance against shock and vibration, flow solderable, protected against over-discharge.



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VARTA Batterie AG, Am Leineufer 51, D-3000 Hannover 21  
VARTA Batteries, Inc., 300 Executive Boulevard, Elmford N.Y. 10523-1202, USA  
VARTA Private Ltd, P.O. Box 55, Bedok North Post Office, Singapore 9146





## Electronic/pneumatic interfacing systems

*Electronic/pneumatic interfacing systems* is a 16-pg catalog that includes descriptions of more than 50 standard, user-friendly modules. Using the company's programming and prompting software, these modules guide you through the control process. The catalog provides a diagram of a typical control system and presents the features and specifications of the various system modules; the publication also contains a list of components and accessories.

**Robitech Inc.**, 10 Upton Drive, Wilmington, MA 01887.

Circle No 714

## Handbook catalogs interfaces for PCs

This handbook describes the company's plug-in boards for data-acquisition and industrial-control interfaces in personal computers, as well as communications interfaces for the IBM PC, PC/XT, PC/AT, and compatibles. It also features digital panel meters and printers. The 130-pg book provides technical specifications and pricing information, along with application and product-configuration guides.

**Metabyte Corp.**, 440 Myles Standish Blvd, Taunton, MA 02780.

Circle No 715

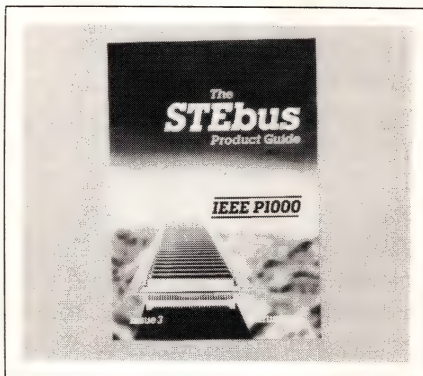
## App note covers fiber-optic product testing

*Testing the IBM Fiber Optic Systems Using a Fotec Test Kit* is a 4-pg application note that covers the testing and troubleshooting of fiber-optic systems using the company's 3044 channel extender and 8219 token-ring LAN repeater. The publication presents step-by-step procedures for testing all system components and troubleshooting installed systems. It also discusses the possibilities of using network systems on fiber-optic networks that differ from IBM's specifications. Four figures supplement the

text. The application note also lists other reference aids on fiber-optic testing available from the manufacturer.

**Fotec Inc.**, Box 246, Boston, MA 02129.

Circle No 718



## Guide details products compatible with STE Bus

The third edition of *The STEbus Product Guide* details over 600 products for the 8-bit STE Bus computer system. Compiled and issued on behalf of the STE Bus Manufacturers' and Users' Group, the 60-pg guide includes products from 31 manufacturers and lists STE Bus product suppliers worldwide. In addition to the more familiar computer boards, the guide details DSP, motor-control, graphics, and instrumentation boards. It also provides a list of system houses that adapt STE Bus systems to customer requirements.

**STE Bus Manufacturers' and Users' Group**, c/o 7 Horseshoe Park, Pangbourne, Berkshire RG8 7JW, UK.

Circle No 722

## LAN books catalogued

This catalog describes 35 books that focus on local-area networks and data communications. The 16-pg pamphlet provides descriptions of books from 15 publishers; for each book, it includes the number of pages, table of contents, price, and year of publication. If you fill out the enclosed postcard, you can receive a

free LAN glossary by requesting that your name be put on the catalog publisher's mailing list.

**Telecom Library Inc.**, 12 W 21st St, New York, NY 10010.

Circle No 717

## Guide explains control/display units

This 8-pg brochure discusses what to look for when selecting a CDU (control/display unit)—a combination keypad for operator input and display for system output. The guide covers the manufacturer's standard line of CDU models, special circuitry, and custom design and manufacturing.

**Termiflex Corp.**, 316 Daniel Webster Hwy, Merrimack NH 03054.

Circle No 716

## Designer's guide to PC bus

This 144-pg manual is a designer's guide to the PC bus. It defines PC-bus hardware specifications and the BIOS calls required to write software for the bus; it also defines pin assignments, signal timing, memory and I/O address maps, electrical requirements, and BIOS interrupt vectors. The directory covers the company's PC and PC/AT bus products, including brief product overviews, technical information, photos, and diagrams.

**Faraday Electronics**, 749 N Mary Ave, Sunnyvale, CA 94086.

Circle No 720

## Catalog details VME Bus product line

This 21-page catalog details a range of VME Bus-compatible products, including CPU, memory, mass-storage-interface, communications, industrial-I/O, and graphics boards, plus available software. It also outlines a range of special-purpose boards based on the company's Flexipm board—a 68000/68010  $\mu$ P-based VME Bus board with half of the double Eurocard configured to

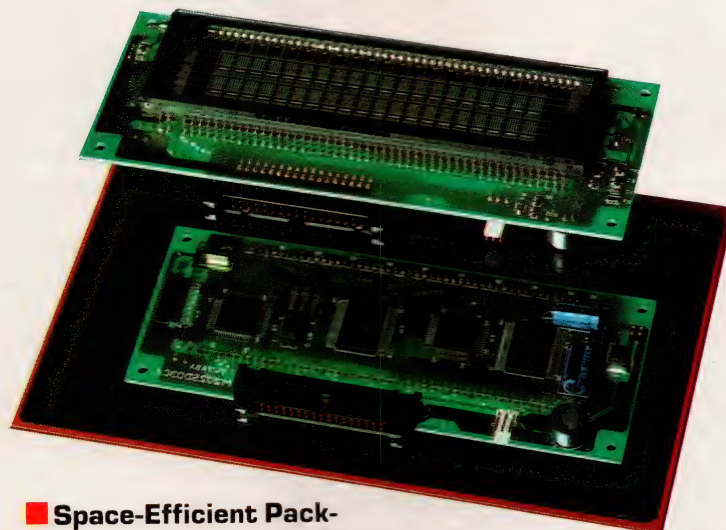


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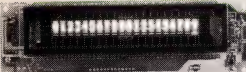
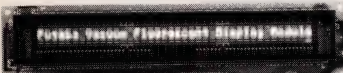

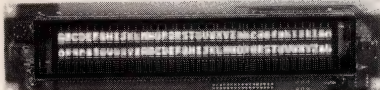
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	M40SD42CA	1 x 40	.344"	9.45" x 2.16" x .88"
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accept a customizing module. Other products include image-processing subsystems and development systems; an EPROM programmer, Camac interface, mother board, and prototyping boards; and VME Bus racks and chassis.

**Data Sud Systemes sa**, Box 1067, rue de la Croix-Verte, 34007 Montpellier Cedex, France.

**Circle No 724**

## Brochure features analog, digital I/O boards

This brochure describes VME Bus and Multibus I/O boards suited to harsh factory environments. Designed to assist systems engineers who are considering open-bus architectures for factory automation or industrial measurement and control, the booklet details methods of interfacing analog and digital I/O signals to the bus and outlines the boards' features, including Accum-

ux isolation technology, onboard signal conditioning, and onboard intelligence with 14-bit resolution.

**Analogic Corp**, Industrial Technology Group, 14 Electronics Ave, Danvers, MA 01923.

**Circle No 721**

## Handbook on VME Bus-compatible boards

This 64-pg, pocket-sized handbook details a range of VME Bus-compatible computer boards. It contains sections on CPU, memory, system-controller, industrial-I/O, intelligent-peripheral-controller, communications, and graphics boards. The handbook also describes fully integrated open-system units, software, and miscellaneous hardware. Other features include comparison tables that help you select boards and quality assurance information on the products. £2.50.

**Thomson Semiconducteurs**, 45

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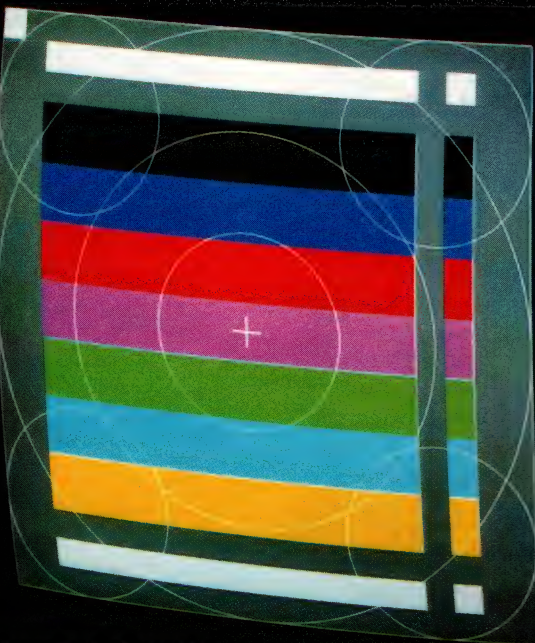
## Brochure depicts fiber-optic kit

This 4-pg, 4-color brochure describes a fiber-optic, RS-232C modem hardware kit. The kit consists of two asynchronous modems and power sources, plus 100 ft of twin fiber-optic cable with assembled connectors. The brochure shows you how to install the device, and it also provides specifications and a parts list.

**Augat Fiberoptics**, 710 Narragansett Park Dr, Pawtucket, RI 02861.

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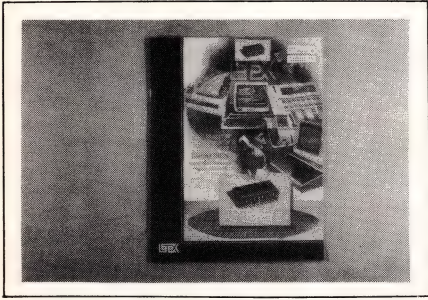
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# LITERATURE: INSTRUMENTS



## Brochure describes ISDN testing

This 8-pg brochure describes test techniques for semiconductors and line cards slated for the Integrated Services Digital Network (ISDN). The document details tests that allow you to make measurements by using high frequencies and simulating effects of the telephone line on encoded signals. Other tests include precisely simulating corrupted encoded waveforms and making measurements such as impedance and longitudinal balance measurements.

**LTX Corp**, LTX Park at University Ave, Westwood, MA 02090.

Circle No 678

## Catalog lists precision references

This catalog of 38 different high-accuracy voltage references covers single- and dual-output 5 and 10V references available in commercial, military, and extended temperature ranges ( $-55$  to  $+200^{\circ}\text{C}$ ). The catalog also provides a selection guide and a cross reference.

**Thaler Corp**, 10940 N Stallard Pl, Tucson, AZ 85704.

Circle No 679

## Article details fiber-optic errors

*When Errors Occur in Digital Lightwave Systems*, a 4-pg reprint of a technical article, discusses digital signaling and how errors occur. It also describes measurement techniques used to uncover the error-producing devices. The article provides background information on

types of errors and details on the CCITT (International Consultative Committee for Telephony and Telegraphy) G.821 performance-analysis technique.

**Intelco Corp**, 8 Craig Rd, Acton, MA 01720.

Circle No 680

## Brochure describes VLSI environment

This 12-pg brochure details the company's implementation of a design-and test-automation environment for VLSI devices and circuits. It describes software tools that run on various computers linked by Ethernet.

**Teradyne Inc**, 321 Harrison Ave, Boston, MA 02118.

Circle No 681

## Brochures cover switching systems

A pair of brochures, *Leadership in Switching Systems* and *Confidence At the Heart of Your System*, cover modular, analog switching systems that handle a dc to 26.5-GHz frequency range. Each brochure consists of a 6-pg folder with individual data sheets on each of the modules and includes full specifications.

**Racal-Dana Instruments Inc**, Box C-19541, Irvine, CA 92713.

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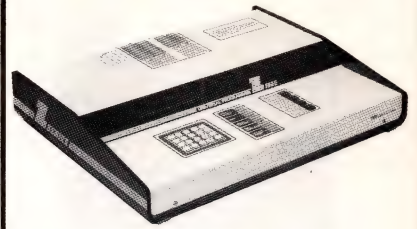
## Synthesized source covered in foldout booklet

*The simpler, The better*, an 8-pg, 4-color brochure, describes a synthesized signal generator, which covers a frequency range of 400 kHz to 1.1 GHz. The brochure explains the source's user-friendly construction and has a full-sized photograph of the instrument with callouts that explain essential controls and displays.

**Wavetek**, Box 190, Beech Grove, IN 46107.

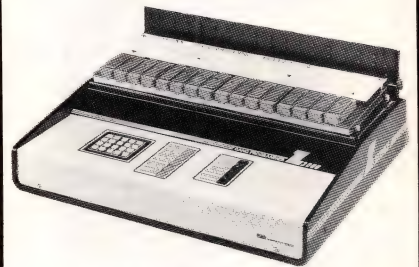
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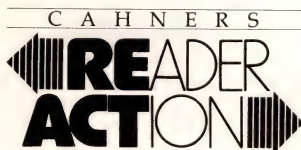
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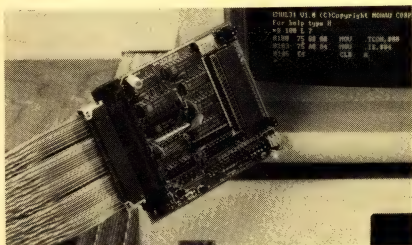
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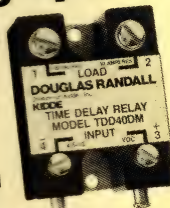
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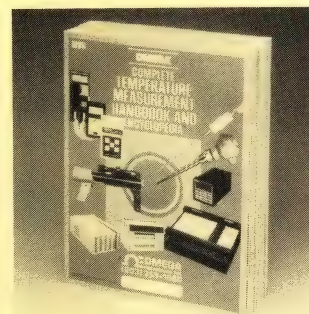
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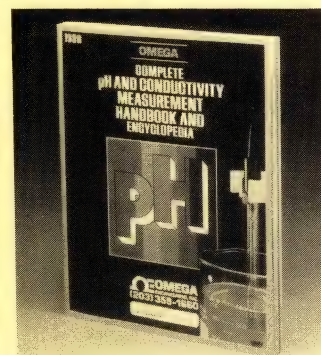
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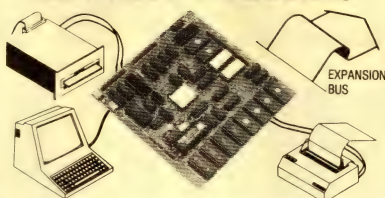




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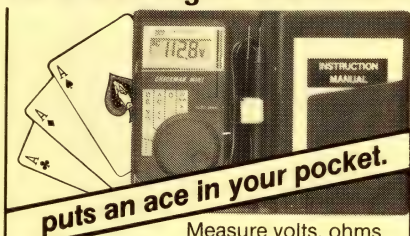
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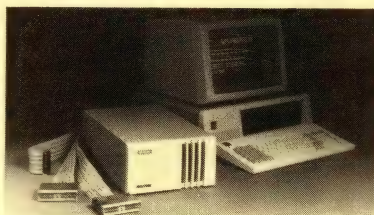
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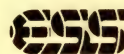
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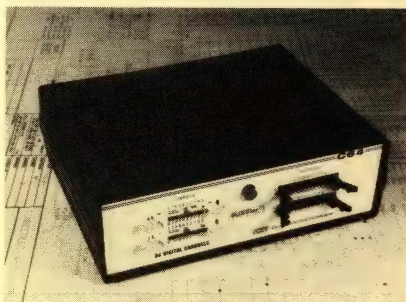
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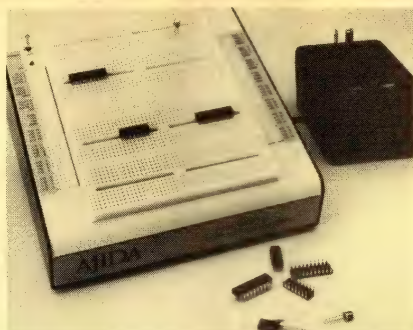
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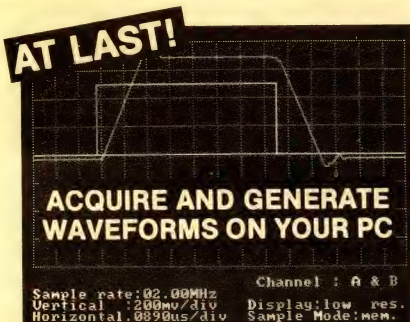
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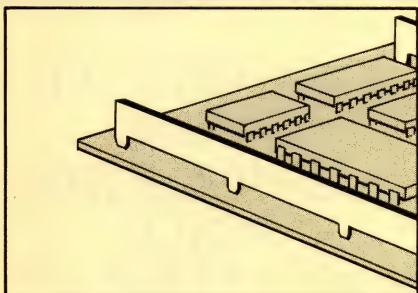
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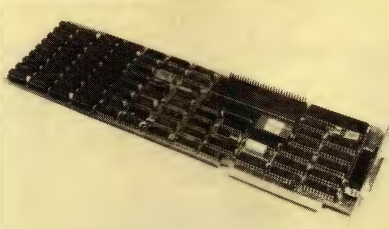
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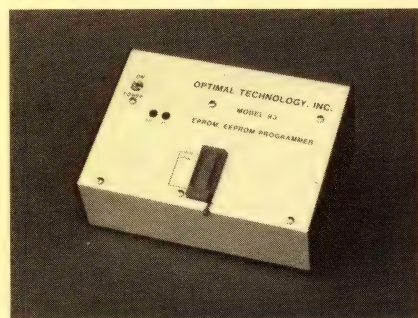
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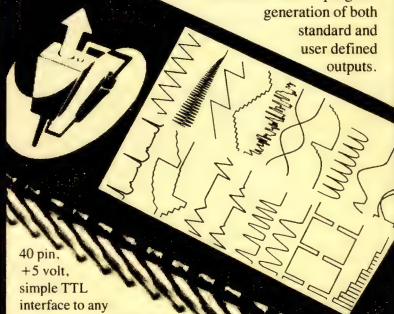
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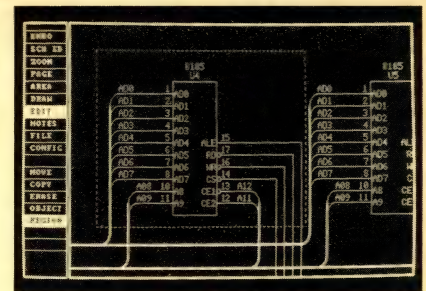
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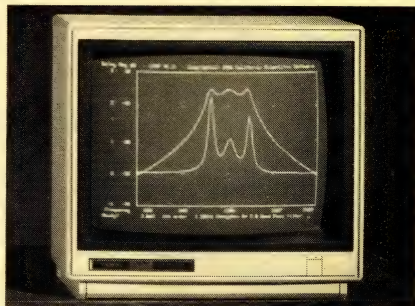
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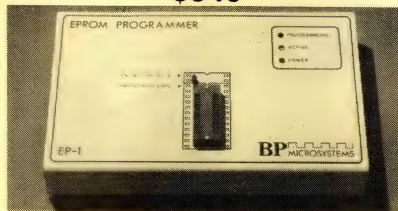
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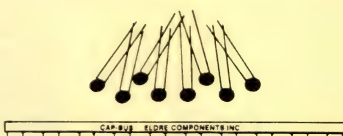
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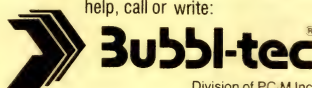
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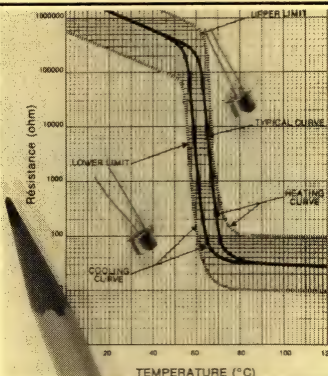


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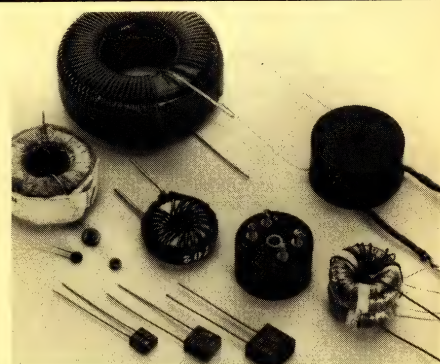
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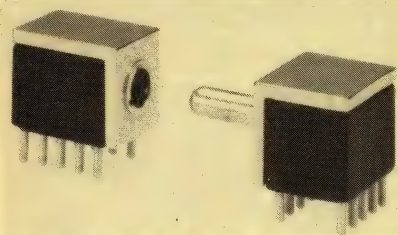


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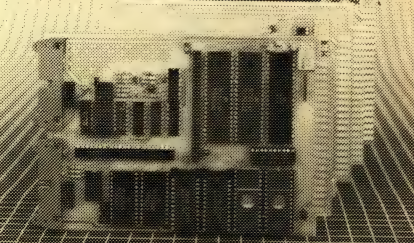
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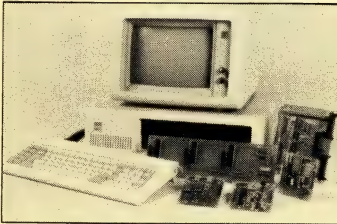
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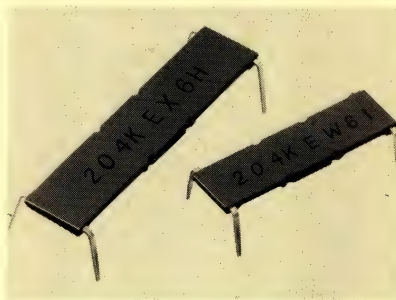


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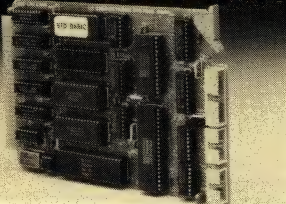
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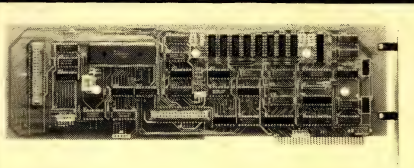
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## Recruiting engineers to the South Bronx is a task less difficult than it seems

Deborah Asbrand, *Staff Editor*



Engineers at 3-year-old Protocom Devices enjoy the same benefits and face the same difficulties as engineers at other start-ups: They pay for the pleasures of hands-on designing and potentially lucrative stock options by working long hours under tight deadlines and related pressures. Yet Protocom's engineers work in a setting far removed from the entrepreneurial enclaves of Silicon Valley or Boston's Route 128. Most of them finish their morning commute when they exit New York's Cross Bronx Expressway and drive into the heart of the South Bronx, where the company's newly constructed headquarters sits amid the vacant lots and abandoned buildings that have made the area a symbol of urban decay.

Protocom's founders had two primary reasons for locating their company in such an unlikely setting. The first was based on the company's market: Protocom makes packet assembler/disassemblers (PADs), devices that let mainframes of various protocols communicate over the

X.25 packet-switched network, and prospective large-scale users of PADs are the banks and investment houses that line nearby Wall Street. The second reason was more personal: The five men who founded the company saw its presence in the South Bronx as a way to bring training opportunities and jobs to the area where some of them had grown up.

Despite its bleak surroundings, Protocom has found attracting engi-

neers to be a surprisingly easy task. Many factors have contributed to its continued success in building its engineering staff. The founders' have drawn on their own engineering experiences—in particular the shortcomings—to fashion a flexible environment that lets engineers contribute to all facets of the company's operations. The company has also tapped local engineering graduates' desire to remain near New York City. What's more, through its active role in the Bronx's rehabilitation, it has added a rare, humanitarian trait to its corporate character.

Even before Protocom's CEO, Rafael Collado, graduated from the electronics engineering program of Brooklyn Polytechnic Institute in the early seventies, experience had

*Part of the staff in front of the company's headquarters. (top)  
Rafael Collado: Providing incentives for engineers. (right)*



Photographs by Sarah Putnam



# PROFESSIONAL ISSUES

taught him that many large companies viewed their engineers, all compartmentalized in neat layers, as human commodities. His father, an engineer for Grumman, was one of the thousands of engineers who lost their jobs during the 1960s. "I knew then that engineers were viewed by most of industry as skilled labor," says Collado. "They didn't get the respect they deserved. They were developing the products, sitting on the cutting edge, and in the end, they were dealt with as consumable resources."

## Staying with a product to the end

What's most harmful to engineers, says Collado, is the piecemeal process that dominates engineering in many large companies. By working only on small pieces of the whole—instead of actively working in the design, testing, manufacturing, and marketing areas—engineers lose their perspective on their role in a product's development. More importantly, he says, they have no sense of the profits they generate for their company. An elegant design isn't just an esoteric piece of technology, he says. "It's an esoteric piece of technology that serves a user's need."

Part of Protocom's strategy for recruiting engineers attempts to bridge the gap between engineers and profits from the products they design. Its engineers' compensation package consists of base salary, stock options, project bonuses, and a percentage of the profits from a product on which they worked. "If an engineer is generating money for Protocom," says Collado, "I should make an incentive for him to generate more. [Incentives] shouldn't just be for salespeople."

The company's small size in itself draws recruits. Engineers know that Protocom, which employs just 60 people, is still too small to have erected barriers between its departments. Thus it offers young engineers, in particular, intensive

technical training in addition to experience in manufacturing, marketing, and sales.

"The experience I'd get here in one year was equal to what I'd get in three or four years with another company," Omar Azmy, a recent graduate of Cooper Union, a small, 4-year college in New York, explains in talking about his decision to join Protocom. "I'm getting a lot of exposure and a lot of responsibility. It was almost guaranteed that I'd get that kind of responsibility because a company this size can't hire 100 engineers right away." Azmy consid-

gave me manuals and said 'go to it,'" he recalls. "I hadn't a clue as to what was going on." But he accepted the challenge of the job, he remembers; he absorbed the manuals and scrambled to learn the technology he needed to complete the project. "In six months, I had learned more than I had in my career as a student."

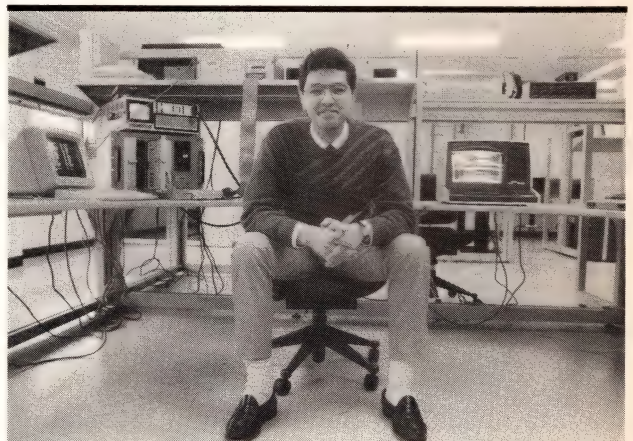
The importance of this sink-or-swim approach so impressed Collado that he now puts it to use at Protocom. Queenie Ma's description of her first experiences at Protocom echo Collado's. "When I first came to work here, they gave me a project

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*Part of Protocom's strategy for recruiting engineers attempts to bridge the gap between the engineers and the profits from the products they design.*

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**Omar Azmy:** *More exposure and responsibility*



ered jobs with Bell Laboratories and other New York area companies, but he chose to accept a position at Protocom based on a friend's recommendation. "He told me 'the company doesn't have an engineering department; rather it is an engineering company.'"

And it's an engineering company whose CEO believes engineering means learning through doing. Collado's first engineering job was at Documation (Melbourne, FL), a small subsidiary of Storage Technology. It was an exhilarating apprenticeship. "When I first started, they

in hardware, which is what I really wanted to do," says Ma, another recent Cooper Union graduate. "But the first month that I was here, I was totally lost. Then I was able to put the project on schedule and learn the work."

Collado says he's committed to preserving a path for advancement for those engineers who want to remain designers. In many of the companies he worked for, the only opportunities for promotion were to managerial positions, a situation that he likens to "telling a surgeon that the only way he can earn pres-



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# PROFESSIONAL ISSUES

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tige and more money is to stop practicing medicine. The only profession that does that to its gifted people is engineering."

To keep design opportunities open to more senior engineers who don't want to be managers, the company has devised a technical post with the title of "at counsel." The position lets engineers work part-time for the company, as consultants of sorts, and use the remainder of their time to work on projects

tastic pent-up engineering talent that was being abused." Students at Polytechnic Institute of Brooklyn, Cooper Union, Columbia University, and other local colleges who wanted to remain in New York, he maintains, have few opportunities beyond what the area's aerospace facilities had to offer.

Collado's estimation of New York residents' desire to remain near the city seems justified, for both Azmy and Ma considered the company's location a plus. But Carlos Aponte, Protocom's director of human resources, sees the company's South Bronx location as a drawback in trying to draft people from other parts of the country. He cites a recent *Boston Globe* recruitment advertisement for software engineers that netted only four inquiries. "The major reason we don't get the Silicon Valley, hot-ticket engineer here is that they don't want to come to the Bronx. There's something symbolic about the Bronx; people are afraid of it."

Not all non-New Yorkers are daunted. Earlier this year, hardware designer John Derewonko turned down a job with a data-communications company in a rural part of Massachusetts to join Protocom. Derewonko lives 30 minutes away from the Bronx in White Plains, a middle-class suburb. He

and one that makes Protocom an exceptional start-up—is its sense of social mission. The founders wanted to do their part to help restore a sense of community to the South Bronx. A \$4.4 million financial package from the Port Authority of New York provided for the construction of 42,000 square feet of office and manufacturing space in Bathgate Industrial Park, which is home to three other companies in addition to Protocom. The company hopes in the near future to add another 100 or so employees to its 60 current workers.

Its sense of social responsibility includes constant training for everyone from hourly employees—who rotate through positions in the mail room, manufacturing, and maintenance, and are eligible for company-paid schooling after one year of employment—to engineers. "If in one engineering team, one engineer stands out . . . , you get suspicious," says Aponte. "Interaction and sharing aren't taking place. For us, social mission means that you've got to train those around you to maximize [their talents]."

Open discussions on racism and sexism with potential employees is another part of the company's policy. Aponte meets with job candidates at all levels and finds that discussion of prejudice leaves many



*Queenie Ma: Learning by doing*

of their own.

Protocom has been equally innovative in taking into account engineers' high turnover rates: The company has made it known that it's open to discussing investments in or joint ventures with employees' start-up projects. Collado envisions the company as "almost a graduate school," fostering employees' creativity until they're ready to take on their own businesses. "Sure, we want to get our products out and make money," he admits, "but at the same time, I know that people will typically leave after two years."

Collado is an indefatigable booster of the company's New York location. His support for the South Bronx site, just 15 minutes out of the city, was partly based on his belief "that New York City had fan-

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*Protocom's CEO believes engineering means learning through doing—the sink-or-swim approach.*

---

says his standard of living is higher now than it was during his four years as a digital designer for GTE in Waltham, MA, and he has few worries about working in the Bronx. "I'm part of the community and I know it well," says Derewonko. "The Bronx," he says, "is not that bad."

Another important dimension—

of them disconcerted. "People ask 'why do you keep bringing up these negative things—racial and gender discrimination?'" says Aponte. "My answer is always the same: Sexism and racism have always existed and will always exist in corporations. The difference between us and other companies is that we talk about it."

Aponte also stresses the minority



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## ISSUES

base of the company. He points out that the president, the chairman of the board, and the directors of five out of six departments in the company belong to minorities. "That is radically different from the corporate experiences of 99.9% of people in this country," he says, and that distinction poses its own problems. "To create an effective company, we have to find people who not only have the right expertise, but are going to feel comfortable working in

*"If in one engineering team, one engineer stands out . . . , you get suspicious."*

a multiracial, multiethnic company."

The director of human resources quickly dismisses the question of whether a company that tries to accommodate everyone's needs can also operate a profitable business. "That is the furthest thing from the truth. Just look at us," he argues, pointing to the company's growth in sales from \$500,000 in 1983 to \$5 million in 1985.

Out of all its creative and innovative programs, Protocom's greatest asset is the policy that allows engineers to be connected to a product at all stages. "What we're trying to do is to take engineering back and make it fun," says Collado. **EDN**

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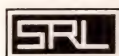
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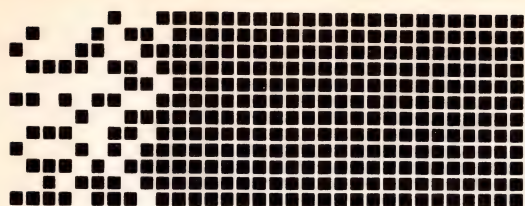
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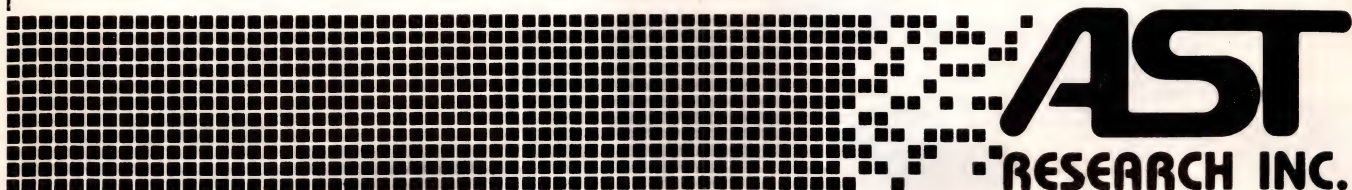
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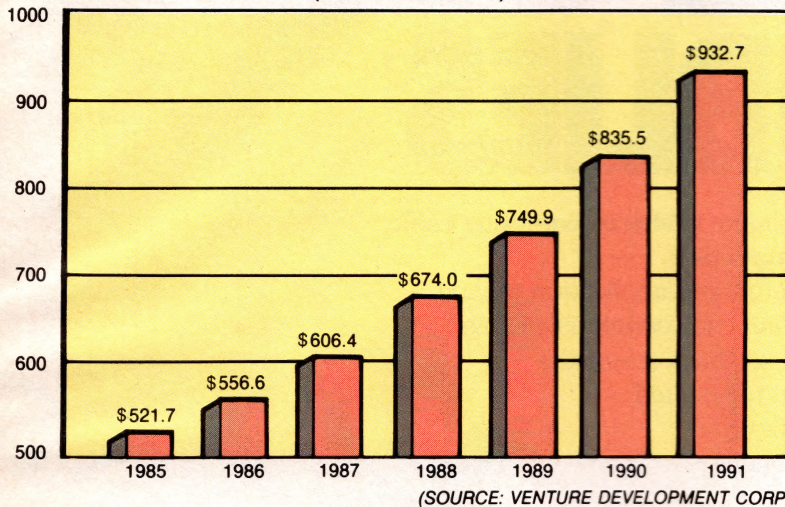
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# LOOKING AHEAD

EDITED BY GEORGE STUBBS

**US SHIPMENTS OF RECTIFIERS**  
(MILLION US \$)



## Rectifier market to grow at a 10.2% annual rate

The value of US shipments of rectifiers, including standard-recovery, fast-recovery, ultrafast-recovery, and Schottky types, totaled \$521.7 million in 1985, reports the market-research company Venture Development Corp (Natick, MA), and should reach \$932.7 million by 1991. The average annual growth rate throughout the period should be about 10.2%.

Though application niches are well established and consumption of devices in all categories will increase, the demand for Schottky rectifiers is expected to grow at the highest rate, says VDC. Although Schottky devices are limited to low-voltage applications, their higher efficiency is attractive to designers who are attempting to build smaller and faster power supplies.

Demands for lower forward voltages than even Schottky rectifiers can achieve have inspired power-semiconductor makers to investigate alternative rectifier technologies. In recent years, synchronous rectifiers have shown voltage drops that are typically half those of comparable Schottky devices. Bipolar and MOSFET versions of synchro-

nous rectifiers are now available, but dollar value of shipments is expected to remain small for the time being, because the devices are still significantly more complex and expensive than Schottky devices.

## Network expenditures: A colossal waste?

The good news—for suppliers of systems and equipment—is that US businesses will have spent approximately \$650 million on local-area computer networks when 1986 sales are finally in. And they will spend about \$740 million in 1987, says Herbert J Martin, president of the Wolongong Group (Los Angeles, CA), a consulting firm in the networking field. The bad news—for users—is that in just a few years, many networks may have to be ripped out of the walls.

Martin says that today's networks are being built in a haphazard fashion, with no concern for the International Standard Organization's (ISO) Open Systems Interconnection (OSI) model for computer networks—a standard that will not receive full specification for at least five years. Compounding the problem, says Martin, is the increasing

use of equipment from different manufacturers in a single organization; this practice often results in incompatible protocols and languages.

One measure of insurance you can take against total reinstallation is to build your network in accordance with the Transmission Control Protocol/Internet Protocol (TCP/IP) used by the Department of Defense. "The great virtue of TCP/IP is its open systems approach to communication," says Martin. "It can be implemented by any computer user, can be transparent to many kinds of operating systems today, and will prepare you to easily migrate to [OSI] when ISO completes its networking standard."

## DP/MIS budgets to stress control over transmission

According to data compiled by Newton-Evans Research Co (Ellicott City, MD), managers and executives in data-processing and management-information-systems departments will allocate a growing portion of their budgets to data-concentration and network-control equipment, as opposed to data-transmission equipment, in 1987.

The respondents' budgets are expected to show a cumulative growth rate of 44% over the 1984 to 1987 period. On a per unit basis, their purchases of data-concentration equipment will be greatest in the port-selector category; the number of installed units is expected to increase by 78%. Respondents indicated that they will increase the number of multiplexers installed by 53%.

The number of 56k-bps, 14.4k-bps, RF-microwave, and broadband modems in use is expected to grow significantly, reports Newton-Evans. Leading suppliers in the various categories of modems are AT&T, Hayes Microsystems, Codex, and Northern Telecom.



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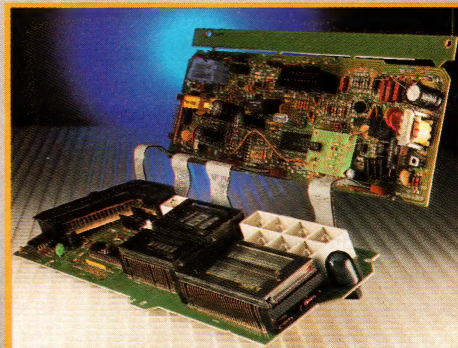
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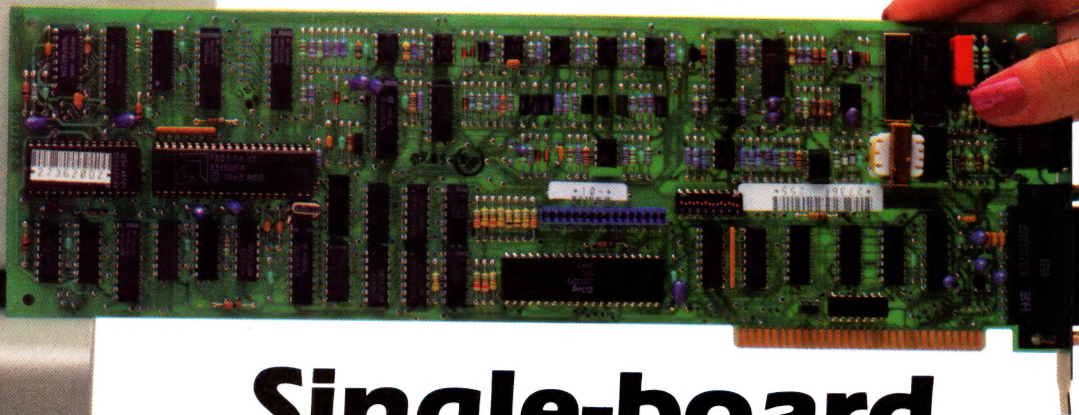
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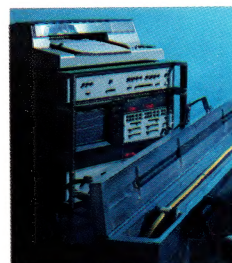
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